Report No. 161

RESEARCH PROGRESS

A special report covering

the PERIOD FROM JANUARY 1, 1956

THROUGH DECEMBER 31, 1956

This report contains a
brief account of experimental
developments of the Arizona
Agricultural Experiment Station

This publication, detailing specific research projects underway is prepared primarily for the internal use of the College of Agriculture, University of Arizona, and for those individuals and institutions particularly concerned with the progress of research of the Agricultural Experiment Station for the period between January 1, 1956 and December 31, 1956; and the status of specific projects as of January 1, 1957. This is supplemental to the printed 67th Annual Report of the Arizona Agricultural Experiment Station.

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UNIVERSITY OF ARIZONA

Tucson

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AGRICULTURAL EXPERIMENT STATION

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Department of
AGRICULTURAL BIOCHEMISTRY

1. UNIDENTIFIED FACTORS IN FOODS AND FEEDS AND THE PHYSIOLOGICAL AVAILABILITY OF VITAMINS, MINERALS, AMINO ACIDS AND THEIR NUTRIENTS.

Project Number: 258A. Funds: Hatch and State. Personnel: M. G. Vavich, A. R. Kemmerer, W. Fleming and Burt Heywang.

The factor or factors in cottonseed meal that cause pink discoloration in cold storage eggs was proved to be in the fatty acid fraction of the oil.

In order to expediate the work the relation of the Halphen Test (AOAC test for cottonseed oil) to the pink discoloration was studied. Eggs from hens that received crude cottonseed oil and from hens that were fed refined cottonseed oil were tested. Eggs that showed pink discoloration gave a positive Halphen Test. Eggs that were not discolored gave a negative test. From the current literature and from our tests we have speculated that the pink discoloration agent may be a cyclic unsaturated 18 carbon chain fatty acid.

The effect of fluorine in drinking water of growing chicks during hot and cool weather was continued. Up to 100 ppm fluoride had no effect on the growth of the chicks. However, bone ash was increased as the fluorine concentration was increased. Results obtained during high temperatures (summer) and those during cool temperatures (winter) did not significantly differ.

2. THE NUTRITIVE VALUES OF SOUTHWESTERN PRODUCED FOODS AND FACTORS AFFECTING THOSE NUTRITIVE VALUES.

Project Number: 258C. Funds: Hatch and State. Personnel: A. R. Kemmerer, M. G. Vavich, N. Raica and W. Fleming.

The nutritive value of the protein of grain sorghums was continued. Microbiological analyses of the grain showed that the proportions of leucine and arginine were high and the proportions of lysine and methionine were low.

The protein of the sorghum was tested by feeding the grain to chicks at an 85% level with and without supplements of methionine, lysine, isoleucine, valine, glycine and threonine. Each amino acid was fed individually and in various combinations. Only lysine or combinations containing lysine produced growth stimulation. Even with lysine growth was not normal and feed utilization was poor. The high proportion of leucine in the grain did not inhibit growth since supplements of isoleucine and valine in combination gave no growth stimulation. Valine and isoleucine have been reported to overcome leucine inhibition. Supplements of 2% meal scraps gave the best growth stimulation.

3. BIOLOGICAL AVAILABILITY AND INTERRELATIONSHIP OF NUTRIENTS IN FOODS.

Project Number: 313-2. Funds: Bj9 and State. Personnel: M. G. Vavich, A. R. Kemmerer, N. Raica, and J. W. Stull.

Last years work showed that milk and certain constituents of milk increased carotene utilization by rats. Some other food constituents decreased utilization. This year attempts to find something in common in foods that either decreased or increased carotene were unsuccessful. Therefore basic experiments on carotene utilization were undertaken. Cortisone, and pathilon which decreases intestinal motility decreased carotene utilization. Neostigmine which increases intestinal motility counteracted the effect of cortisone. It appears from this preliminary work that substances that increase intestinal motility increase carotene utilization and substances that decrease intestinal motility decrease carotene utilization. Carotene utilization therefore may be related to the effect that a component in a food has upon intestinal motility. Information as to why foods produce such reactions is of basic importance in human and animal nutrition.

4. POLLEN SUBSTITUTE FOR HONEYBEES.

Project Number: 382. Funds: Hatch and State. Personnel: A. R. Kemmerer, William McCaughey, F. Todd, S. McGreger, and L. N. Standifer.

The essential amino acid contents and crude protein values were determined for the following pollens: cotton, date, alder, sugarbeet, and dandelion. Some non-essential amino acids were determined for the following pollens: Greasewood, alfalfa, pigweed, sorghum, hegari, corn, cotton, date, sugarbeet, alder, and dandelion. Water, ether, and alcoholic extracts of ten pollens were examined for any stimulatory effect on the growth of test microorganisms. Eight of the alcoholic, seven of the aqueous, and two of the ether extracts showed stimulation. Freshly collected date pollen was found to contain about 55 ppm each of alpha-ketoglutaric and pyruvic acids.

Preliminary feeding tests with bees have been carried out. Necessary methodology on mechanics of caging, feeding methods, diet levels, and evaluation of bee acceptability and physiological response has been accomplished. Some observations concerning diet testing with bees are: none of the diets tested so far yielded as good a development of the pharyngeal gland as did the control pollens; a diet in which soybean flour was replaced with casein yielded somewhat better gland development; there was an indication of lessened bee acceptability for a diet containing pantothenic acid when compared with one in which this vitamin was omitted; significant differences were observed among various control pollens fed both as to bee acceptability and gland development.

5. THE RELATIONSHIP OF FAT, BULK AND OTHER CONSTITUENTS OF THE DIET TO BLOOD CHOLESTEROL.

Project Number: 410. Funds: Bj9 W-44. Personnel: A. R. Kemmerer, M. G. Vavich, and M. Pasvogel.

Approximately 2/3 of the deaths of people over 65 years of age are caused by cardiovascular diseases. The amount of cholesterol in blood has been shown to be closely related to many of these diseases. The object of this project was to determine factors in the diet that might influence the amount of cholesterol in the blood. Laying hens, 18 months of age, were fed laying mash supplemented with combinations of cholesterol, methionine and choline. After 8 weeks on experimental diets the blood of hens which received (1) laying mash, only, contained 162 mg. cholesterol per 100 ml.; (2) laying mash plus 1% cholesterol, 330 mg. per 100 ml.; (3) laying mash plus 1% cholesterol plus 1% DL methionine 244 mg. per 100 ml.; and laying mash plus 1% cholesterol plus 1% choline 202 mg. per 100 ml. It is apparent that methionine and choline lowered blood cholesterol in the laying hen.

6. INVESTIGATIONS OF PROTEOLYTIC ENZYME REACTIONS IN RELATION TO THEUMATOID ARTHRITIS.

Project Number: H 490 - C - 7. Funds: Federal U. S. Public Health. Personnel: Alice Stanfield, Valde Richters, Margie McCaughey.

The work on the effect of antirheumatic agents on enzyme systems was continued. These systems were found to exert no effect on the transaminating enzymes in livers.

A study on the relation of rheumatoid arthritis to antigen-antibody mechanisms was started.

The findings of Petersen and Campbell were confirmed in this laboratory when antibodies against bacterial antigens were produced in the udder of the cow. Patients with rheumatoid arthritis were fed dehydrated streptococcal antibody milk. A rise in serum titre occurred but results of Erythrocyte sedimentation rate, total proteins, serum reactions, and C-reactive protein tests showed no significant changes. There was no measureable improvement in the disease.

In an attempt to prove whether antibody absorbed from milk through the GI tract were protective, rabbits were fed pneumococcal antibody milk and later challenged with lethal doses of organisms. Treated rabbits showed 100% survival time, negative blood cultures, negligible loss of weight, better food intake and lower Erythrocyte sedimentation rate than those from the untreated group. Mouse protection tests are in progress using sera obtained from individuals initially and after ingestion of antibody milk.

Department of
AGRICULTURAL CHEMISTRY AND SOILS

1. WEATHER (IN COOPERATION WITH THE U. S. WEATHER BUREAU).

Project Number: 160. Funds: State. Personnel: H. V. Smith.

Routine weather observations have been made during the course of the year. Copies of the results of the observations are mailed monthly to the San Francisco Weather Records Processing Center where they are tabulated on I.B.M. cards and made a part of the National Weather records.

It is planned to continue the cooperative weather observations during 1957 as has been done in the past.

Cooperative weather observations including those from the Univ. of Ariz. are published monthly by the U. S. Weather Bureau. Ariz. Agric. Expt. Sta. Bul. No. 279 (The Climate of Arizona) was published late in 1956. It is a 90-page report of the climatic condition of all active weather stations in Arizona.

2. A LYSIMETER STUDY OF THE NITROGEN BALANCE IN IRRIGATED ARID SOILS.

Project Number: 169. Funds: Hatch and State. Personnel: H. V. Smith.

In the spring of 1956 the lysimeters had to be abandoned to make way for the new Biological Sciences building. Before construction of the new building was started some soil from each of the lysimeters was removed and stored in garbage cans for laboratory work. This project is being concluded this year.

It is planned to grow plants in the greenhouse to determine the fertility status of the soils with particular reference to nitrogen, phosphorus and potassium. A laboratory evaluation of the soils will be attempted for these same elements. It is then hoped that the results can be written for publication and the project closed.

3. NUTRITIONAL, CHEMICAL, AND PHYSICAL STUDIES ON THE MORE IMPORTANT SOIL TYPES IN ARIZONA.

Project Number: 265. Funds: Hatch and State. Personnel: H. V. Smith.

In addition to the 76 samples of soil collected from the Navajo County area last year 92 additional samples were collected by the Soil Conservation Service this year. Considerable progress has been made in the laboratory during the year on the analysis of these samples. In addition to the investigation of the soils on the Navajo County survey several correlation soil sampling trips were made cooperatively with officials of the Soil Conservation Service. During the year

soil samples were obtained from the Gila Watershed, the Laguna S.C.D., the Walnut Gulch Watershed and the East Maricopa S.C.D. Over 70 additional samples were collected from these districts and good progress is being made in the laboratory in the analysis of these soils. To date 11 separate determinations have been made on each soil. The graduate student who has been studying the range of characteristics which are found in the Mohave and related series is completing his laboratory work on the problem and is beginning to write his thesis. The graduate student who was studying infiltration rates as affected by tillage and orchard traffic on the Adelanto soils on the Tempe Citrus farm completed his thesis in May 1956 and has returned to Israel. A third graduate student is at present investigating the relationship of various concentrations of NaCl and Na_2SO_4 on the stability of clay suspensions during the sedimentation period in mechanical analysis. Final results have not yet been obtained so critical concentrations are yet unknown.

The laboratory results on the soils from the Walnut Gulch Watershed have been turned over to the project leader for inclusion in the over-all report of the area. The characterization study of the Mohave and related soil series is now being concluded and being written in manuscript form. The soil surveyor should be better able to recognize soil series included in these studies and to be aware of the range in characteristics permissible in the Mohave series. Traffic pans between tree rows on the University Citrus Farm at Tempe were found to retard the entrance of water into the soil. This pan can be broken up with a subsoiler. If subsoiling is to be practiced the area to be ripped should be examined for roots and only the areas relatively free from roots should be treated. Series characterization is the most important use which will be made of the soil analyses from each of the soil survey areas. Later the analyses may be used in farm planning operations.

Field reviews will be made in the following areas during the next year. It is hoped to collect soil profile samples for analysis from each of the areas visited and listed below. 1. Winkleman and Casa Grande, 2. Apache Co., 3. Tonto S.C.D., 4. Yavapai Co., 5. Cochise Co. It is also hoped to make a plant food study of several soil series to determine some of the series which are deficient in one or more of the elements of fertility.

Publication Issued: Subsoil Tillage as an Aid in the Reclamation of the Soils in the Casa Grande Series in Arizona. P. M. Mirchandani and H. V. Smith. Jour. of Soil and Water Conservation in India. 1955, Vol. 4, No. 1, pp. 23-30.

4. FERTILIZATION OF FIELD CROPS ON ALKALINE-CALCAREOUS SOILS, OF DIFFERENT TYPES, UNDER SEMI-ARID AND IRRIGATED CONDITIONS.

Project Number: 266. Funds: Hatch and State. Personnel: T. C. Tucker, J. L. Abbott and C. O. Stanberry.

There is a belief among some people that nitrogen fertilization has a place in an alfalfa program in Arizona where photosynthesis is at a maximum because of the high incidence of sunlight. An experiment was designed to test this hypothesis. A four-year-old stand of alfalfa was given N at rates of 0, 75, and 150 lbs. N/A and P_2O_5 at rates of 0 and 75 lbs/A. Neither N nor P alone or in combination gave significant hay-yield increases over the control. Apparently the soil was well supplied with available P and contained some available N.

Symptoms similar to K deficiency were found in some fields of alfalfa in the Salt River Valley area. Four such fields were selected and given K_2SO_4 at a rate of 0 and 415 lbs. K/A. All hay samples were found to contain large quantities of K. In no instance did K increase the yield over the control. Magnesium at a rate of 137 lbs. Mg/A was applied to a 4-year-old alfalfa field along with potassium. There was no yield response to this treatment. A mobile research unit for fertilizer application to small grain and row crops has been assembled. The equipment consists of a Farmall 200 tractor equipped with endless-belt fertilizer distributors and deep applicator shanks, a tilt-top trailer, and a grain drill. This equipment is being used to establish fertilizer experiments on farmer cooperator fields and experiment station farms. Two fertilizer experiments with barley and one with wheat have been established and will be harvested this year.

Fertilizer experiments are designed as a basis for making sound recommendations to the farmer regarding fertilizer application and irrigation practices.

Fertilizer experiments are planned at 8 locations for cotton, 7 locations for grain sorghum, and 1 for corn. The treatments will involve three ratios of nitrogen and two of phosphorus in a factional arrangement. Additional treatments including potassium, trace elements, and nitrogen side dressing will be used. Moisture and fertilizer interrelations will be studied with cotton and grain sorghum. The small grain fertilizer interrelations will be studied with cotton and grain sorghum. The small grain fertilizer program will be expanded. Yield data in addition to tissue and soil analyses will be sought.

5. THE AVAILABILITY OF NATIVE SOIL PHOSPHATE AND NEW COMMERCIAL PHOSPHATE FERTILIZERS IN ARIZONA CALCAREOUS SOILS. (IN COOPERATION WITH THE USDA, AGRICULTURAL RESEARCH SERVICE, SOIL AND WATER CONSERVATION RESEARCH BRANCH AND HYDROLOGY BRANCH, AND THE CALIFORNIA SPRAY-CHEMICAL CORPORATION.)

Project Number: 280. Funds: Hatch and State. Personnel: W. H. Fuller, C. O. Stanberry, T. C. Tucker, and Joel Fletcher.

A new cooperative project on phosphate placement with Dr. C. O. Stanberry of the ARS at Yuma was initiated this year. Because of high temperature and often low moisture content of the upper few inches of the soil, experimentation was begun to determine the effect of depth of placement by alfalfa on utilization of fertilizer phosphorus. A large area was excavated to a depth of 4 feet and phosphate placed at various depths during the filling process. Alfalfa was planted. First results indicate that alfalfa can take phosphorus from great depths. The study of nitric phosphates was continued. The effect of water solubility on availability indicates that this factor is much less prominent with broadcast than banded fertilizer. An equilibrium-extraction technique was developed for determining the availability of P in contact with soils. It involved repeated extraction of soil-fertilizer mixtures with water at a moisture level of a saturated paste. The results closely correlated with that of plant growth and P uptake by plants in the greenhouse.

New research on the influence of water-solubility, placement, and particle size of N and P mixed fertilizers as plant uptake in calcareous soils is being initiated cooperatively with the Tennessee Valley Authority. Field experiments are underway to test new phosphates and correlate uptake with tests in the laboratory and greenhouse. Range fertilization work is underway with Joel Fletcher of the ARS Hydrology Branch.

These investigations are designed to give the farmer a greater return for his dollar spent for phosphate fertilizers. The factors affecting the efficiency of the fertilizers in the soils are being evaluated.

A greatly expanded field research program is underway. Field testing of new commercial phosphates supplied by TVA is being undertaken. Additional study on the influence of water solubility, particle size, and placement of mixed N and P fertilizers will be made in a coordinated laboratory, greenhouse, and field investigation.

Publications Issued: Nitric Phosphate Fertilizers: I. Solubility Characteristics in Some Calcareous Soils. W. H. Fuller. Jour. Agric. and Food Chemistry (in press).

Nitric Phosphate Fertilizers: II. Comparative Effectiveness Using the Greenhouse Pot-Culture Technique. W. H. Fuller and W. Fred Riley. Jour. Agric. and Food Chem. (in press).

6. THE NATURE OF MICROFLORA AND THEIR ACTIVITY IN ARIZONA SOILS AS AFFECTED BY SOIL TEMPERATURE, MOISTURE, SALINITY, pH, AND OTHER FACTORS PECULIAR TO SEMI-ARID SOILS. (IN COOPERATION WITH THE U. S. ATOMIC ENERGY COMMISSION AND WESTVACO CHEMICAL COMPANY, DIVISION OF FOOD AND MACHINERY CORPORATION).

Project Number: 283. Funds: Hatch and State. Personnel: W. H. Fuller.

The application of solutions of inorganic P fertilizers to crop residues before the residues are tilled into the soil is now widespread practice in the Southwest. This practice is centered around the hope that the fertilizer P will remain at a high level of availability as a result of this procedure than if it were added directly to the soil. Results with wheat straw and wheat straw composts containing tagged P^{32} indicate that a relatively greater amount of P is utilized by plants from compost than from noncompost material. According to the data obtained, it must be concluded that there is no particular advantage of adding liquid H_3PO_4 fertilizers directly to straw before incorporating them into calcareous soils over the practice of applying the fertilizer and straw independently.

The effect of decomposing crop residues on the uptake of native soil phosphorus and calcium were studied using radioactive tracer techniques. The work is not sufficiently advanced to draw firm conclusions. It appears, however, the presence of P-free and Ca-free plant residues assist in making native P and Ca more available to plants during the decomposition process. Work on N-fixation by soil algae is underway.

Prior to the abundance of radioisotope for research the contribution of plant residues to the economy of the succeeding crop was not definitely known. This investigation has done considerable to provide knowledge in this field.

Continuation of research on the influence of crop residues on the availability of native soil elements. New research designed to determine the importance of algae in N-fixation in soils. The factors influencing this fixation will be studied. Heavy nitrogen N^{15} will be used to evaluate fixation.

Publications issued: Some Factors Influencing the Utilization of Phosphorus from Crop Residues. W. H. Fuller, D. R. Nielsen, and R. W. Miller. Am. Soc. Soil Sci. Proc. 20:218-224 (1956).

The Influence of Straw and Straw-Fertilizer-Composts on the Uptake of Fertilizer Phosphorus by Plants. W. H. Fuller and D. R. Nielsen. Am. Soc. Soil Sci. Proc. (in press).

7. STUDY OF THE EFFECT OF TEMPERATURE VARIATION ON VARIOUS CHEMICAL AND PHYSICAL SOIL PROPERTIES WHICH AFFECT FERTILITY.

Project Number: 289. Funds: Hatch and State. Personnel: R. H. Maier.

The great diurnal change in temperature in Arizona prompted the development of this project. Nutrient uptake appears to be greatly influenced by soil temperature changes. Phosphorus, for example, is taken up in larger amounts during warm weather than cold. This uptake must take into consideration the temperature of the aerial parts as well as the roots and soil. Temperature control units for soil and roots and for foliage have been designed and ordered. An extensive experiment for the greenhouse has been organized. As soon as summer temperatures subside the experiment will be undertaken. During the hot summer weather the control equipment will be installed and controlled experiments on soils alone in the laboratory will be undertaken.

Fundamental studies of temperature effects on exchange equilibra involving single and double ion systems will be undertaken. Studies of the effect of soil temperature as well as foliage temperature on the uptake of certain plant nutrients and growth of plants will be made.

8. ARIZONA SOIL SURVEYS (IN COOPERATION WITH SOIL CONSERVATION SERVICE AND AGRIC. RESEARCH ADMINISTRATION).

Project Number: 326. Funds: State Research. Personnel: H. V. Smith, members of the SCS and ARA.

Field mapping by the Soil Conservation Service has been continued in all of the Conservation districts during the past year. Field reviews of surveyed areas were made in the Yuma Valley area, the Walnut Gulch Watershed, the Santa Cruz area, the Salt River Valley, the Laguna Soil Conservation District, and the Upper Gila or San Simon area. Most of the soil samples taken in the areas which have been surveyed have undergone analyses for several of the series characterization tests but additional time consuming studies remain to be completed. The writer participated in the 3rd annual conference of the Western Regional Soil Survey Work Planning Group in Portland in February 1957.

No further work was done on the soil association map during the year. Publication within two years of a soil association map of the eleven western states is one of the objectives of the Western Regional Soil Survey Work Planning Conference.

Soil surveys are used as a basis for farm planning, for rating soils, and for determining the special field practices which may be necessary for the production of various crops. They are also a part of the state and national cooperative program, the object of which is to classify all of the lands in the nation so that if soil for a given purpose is needed it can be easily located. The same is true in locating soils should an expansion of crop land acreage seem desirable.

Field reviews of the following soil survey areas for the coming year have already been scheduled. The areas include Winkleman, Casa Grande, Apache County, Tonto SCD, Yavapai Co., Cochise Co., and West Maricopa County. Laboratory work will be conducted on all of the more important soil types being mapped in the state.

The report for Navajo County is being written by the SCS party chief.

9. SOIL STRUCTURE AS AFFECTED BY SOIL AMENDMENTS.

Project Number: 369 (Reg. No. W-30). Funds: Hatch and State. Personnel: T. C. Tucker, J. L. Abbott, W. T. McGeorge, and W. H. Fuller.

The first phase of a soil amendment experiment on a soil high in exchangeable sodium in the Safford Valley has been completed. The objective was to further investigate the relative value of a number of amendments alone and in combination for improving the soil structure. Previous experiments on this soil indicated that, with gypsum added at a rate of 10 Tons/A and sulfur at a rate of 2 Tons/A, water penetration and some physical properties could be improved. The effects of gypsum, were temporary and did not carry over to the succeeding season. There were 4 general classes of soil conditioners used; (a) calcium salts, (b) iron salts, (c) calcium producing materials, and (d) organic polyelectrolytes. There was as much difference in the effect of these materials on the soil characteristics among materials in a single group as between different groups. The influence of these soil conditioners on the measured physical and chemical characteristics of the soil appeared to be very short lasting. Certain materials, Orzan A, Ca-polysulfide, Western Sulfur Soil, and Ferro-Soil-Till were not effective in improving chemical and physical conditions of the soil or alfalfa production. Some benefits were obtained from "Krilium", gypsum, sulfur, and sulfuric acid. An investigation by W. T. McGeorge comparing 6 commonly used methods for determining the gypsum requirement of alkali soils was completed. All methods gave similar conclusions regarding gypsum requirements except one, the Sawarbi and Abdel-Bar titration method. McGeorge-Breazeale method compared favorably with the others. An electro-reclamation experiment was undertaken. Beneficial effect on soil or plant growth was not obtained by electro-reclamation treatment.

The experiments showed that certain soil conditioners are not effective in improving crop yield at the rates recommended. Other materials such as sulfuric acid, sulfur, gypsum, and polyelectrolyte "Krilium" (IBMA) do improve the soil structure. The cost of adding large amounts of these materials is prohibitive for usual farm practice. "Electro-Reclamation" did not improve crop production.

The effect of water quality, leaching and sulfuric acid on soil structure will be studied. The residual effect of the soil conditioners reported above will be studied using barley as a test crop. Effect of certain tillage and cultural practices also will be investigated to determine their effect on soil structure.

Publications issued:

"Electro-Reclamation". J. L. Abbott. Univ. of Ariz. Agri. Expt. Sta. Report #150. 1957.

The Gypsum Requirement of Alkali Soils. W. T. McGeorge. Report Series (in press).

Polysulfides as Soil Conditioners. Univ. Ariz. Expt. Sta. Tech. Bul. 131. June 1956.

Some properties of a soil having high percentage of replaceable potassium: Field and lab. studies on comparative value of soil conditioners. W. T. McGeorge, J. L. Abbott, and E. L. Breazeale. Univ. of Ariz. Agric. Expt. Sta. Report No. 132. June 1956.

10. THE INFLUENCE OF BED SHAPE, PLANTING AND IRRIGATION PRACTICES ON THE GERMINATION AND YIELD OF ROW-CROPS ON SALINE SOIL.

Project Number: 409. Funds: Hatch and State. Personnel: T. C. Tucker, C. O. Stanberry, J. L. Abbott, and W. H. Fuller.

An experiment was undertaken in the Safford Area on a soil high in exchangeable sodium. North and South bed slopes were shaped as well as conventional single row beds. Cotton was planted. It was found that higher beds are necessary to prevent water from washing away the bed shape than was provided because of the high dispersability of the soil. No general recommendations can be made at this time. Because of departmental personnel changes this work could not be undertaken in as extensive a program as was desired until this spring. Dr. C. O. Stanberry of the ARS is cooperating with us on this problem. The new U.S.D.A. bed-shaper will be used by University personnel for making beds. This shaper will provide much better beds than could be made with the equipment available last season.

The problem will be pursued as outlined in the project originally presented last summer.

11. UTILIZATION OF PHOSPHORUS FROM BIOLOGICAL MATERIALS AND UPTAKE OF STRONTIUM BY VARIOUS TYPE CROPS.

Funds: U. S. Atomic Energy Commission. Personnel: W. H. Fuller, W. Fred Riley and Paul Prechel.

Research centered around the uptake by plants of strontium^{89} and calcium^{45} added to calcareous soils in a soluble form as influenced by length of time of contact between soil and the radioactive elements. Both the added soluble calcium and strontium remained rather available throughout the time of the investigation. Both elements usually decreased in concentration, per unit dry plant weight basis, in successive crops. The Ca(soil)/Sr(added Sr^{89}) ratio increased

with successive crops in almost every case. The concentration of the added Ca^{45} and Sr^{89} in the plants decreased when the soils were allowed to incubate for a time with the radiosalts before planting.

Calcium availability in calcareous soils was investigated by the Neubauer Technique. Radiocalcium salts, one soluble calcium acetate and the other relatively insoluble calcium carbonate, were added to calcareous soils. The uptake by grasses from the added soluble source indicated limited availability of native soil calcium carbonate. Calcium as acetate was taken up in quantities 100 fold greater than Ca as carbonate.

Suggested atomic powered industries pose a problem of disposal of waste of fission products. Radiostrontium appears to be one of the most biologically hazardous products of such wastes. Contamination of food through the uptake by crop plants is a possibility, though only remotely possible with controlled industries. This study is designed to study the factors that influence the rate of entrance of radioelements into the food chain from the soil.

Continuation of studies on concentration of Sr^{89} in edible parts of crop plants. Effect of the organic part of crop residues on the availability of indigenous soil phosphorus, calcium, and strontium.

Publications issued:

Availability of Calcium in Calcareous Soils. 1956. W. H. Flocker and W. H. Fuller. Soil Sci. Soc. Am. Proc. 20:387-391.

Thesis. Paul Braswell. The Uptake of Soluble Tagged Calcium and Strontium by Plants as Influenced by Time of Contact Between the Soil and the Added Element. Univ. Ariz. Lib. 1956.

Thesis. Theodore Hymowitz. The Influence of Crop Residues on the Availability to Plants of Native Soil Calcium and Phosphorus. Univ. Ariz. Lib. 1956.

Thesis. Josef Noy. The Availability of Calcium and Calcium-Potassium-Iron Relationships in Plants Grown in Calcareous Soils. Univ. Ariz. Lib. 1956.

12. MISCELLANEOUS STUDIES: NAMELY (a) NUTRITIONAL UPTAKE AND TRANSPORT BY PLANTS, (b) EFFECT OF TEMPERATURE ON MOISTURE MOVEMENT IN SOILS, (c) MINERAL CONTENT OF ALFALFA, (d) CHLOROSIS, AND (e) NITROGEN METABOLISM OF TERMITES.

Funds: State Research. Personnel: E. L. Breazeale.

(a) Nutritional Uptake and Transport by Plants - Using a technique involving placement of "soil-collars" around stems of tomato plants and soils having varying placement of N, P, and K salts in the "collars" it was shown that the plants would absorb nutrients from one zone, transport them to a second, and exude them into the soil or solution through the roots. (b) Effect of Temperature on Moisture Movement in Soil - Data indicate that in some of the soils an

increase in temperature has a tendency to increase water movement as shown by the capillary rise and perculation tests. Some of the soils showed a decrease with increased temperature. Where a high application of gypsum would decrease the movement of water and larger applications increase the response, it was noted that the phenomenon was magnified with either an increase or decrease in temperature. (c) Mineral Content of Alfalfa - Results of samples from 9 areas in Arizona showed that there was no deficiency in any of the samples as far as the major elements were concerned. None of the minor elements were low. (d) Chlorosis- The tests show that iron becomes immobilized in roots and leaves of plants, particularly those growing in alkaline-calcareous soils, and that the Neubauer Technique is well adapted to a study of this property of iron. Additional supporting evidence of iron immobilization was obtained by using the polarograph. When a polarograph is connected across a plant or part of a plant the breaks in the polarogram should represent currents proportional to the ions in the plant. The polarograph study showed that the percent "active" iron in the plant increased, the break in the polarogram disappeared, and the green color was restored to the chlorotic leaves. (e) The Relation of Microorganisms to the Nitrogen Metabolism of Termites - Bacteria were isolated from an unidentified species of Kalothermes, which when inoculated into nitrogen free manitol solution fixed quantities of nitrogen varying from 0.4 to 1.3 mgm.

Mineral content of alfalfa shows that neither major or minor elements are deficient. Considerable alfalfa is grown for hay in Arizona.

Translocation of nutrients by tomato plants. Effect of moisture on nutrient uptake. Effect of temperature on water movement in soil.

Publications issued:

Mineral Content of Arizona Grown Alfalfa with Particular Reference to Minor Elements. E. L. Breazeale and W. T. McGeorge. Report 126.

Application of the Neubauer Technique and Applied Potential to the Study of Immobilization of Iron in Plants. W. T. McGeorge and E. L. Breazeale. Tech. Paper 382. Soil Sci. 82:329-36 (1956).

Department of
AGRICULTURAL ECONOMICS

1. SUPPLY PRICE RELATIONSHIPS AND TRENDS AS THEY APPLY TO ARIZONA FARM AND RANCH PRODUCTS.

Project Number: 196. Funds: State Research. Personnel: George W. Barr.

Accumulation and compilation of supply-price data for Arizona agricultural products was continued during 1955. This data is compiled from secondary sources and from original sources where satisfactory secondary data is not available.

Analysis of this data was made to show trends in prices, income, supplies, and costs for the principal Arizona agricultural commodities.

Farmers and ranchers are kept informed concerning economic developments in Arizona's agriculture through a publication issued annually in January.

Publication prepared was Arizona Agricultural Experiment Station Bulletin No. 281, "Arizona Agriculture 1957".

2. THE RELATIONSHIP BETWEEN THE PRICE RECEIVED BY FARMERS AT GIN POINTS AND THE QUALITY OF COTTON, CENTRAL ARIZONA.

Project Number: 267 (SM-1). Funds: Regional Research and State.
Personnel: Norman E. Landgren.

This project was closed June 30, 1956.

From this study a number of conclusions can be reached: (1) The level of prices in the Memphis market is quite accurately reflected in the Phoenix cotton market. After prices were adjusted for the locational disadvantage of the Phoenix market, there appeared to be a general tendency for the Phoenix prices to exceed those in Memphis during the early part of the season, and for the Phoenix prices to be discounted the most near the end of the season. (2) Premiums and discounts for quality in the Phoenix market are closely related to those prevailing in the Memphis market. Normally 100 points per pound price distinction between qualities in the Memphis market can be associated with at least 70 points per pound price difference between the same qualities in the Phoenix market. (3) The size of the lot sold in the Phoenix cotton market has no consistent effect upon the price paid for the cotton in the lot. (4) The degree of quality uniformity among the bales comprising a lot has no consistent effect upon the price paid.

Publications: Arizona Agricultural Experiment Station Report 142 "The Influence of Some Factors on Prices in the Phoenix Cotton Market."

Manuscript Prepared: "Cotton Price Relationship in Farmers' Local Markets."

3. MARKETING ARIZONA HEAD LETTUCE WITH SPECIAL REFERENCE TO PACKAGING AND COOLING METHODS AND TO THE POSSIBILITIES OF MARKET CONTROL PROGRAMS.

Project Number: 316 (WM-14). Funds: Regional Research and State. Personnel: R. S. McGlothlin and O'Dean Hubbard.

An analysis of economic trends relating to the lettuce industry has been completed. This study provides detailed information on the growth of the industry; changes in the importance of the various producing areas and markets; variations in prices and marketings; and examines the problem of instability in production, shipments, and prices.

The analysis of factors affecting the price of western lettuce has been completed for the various areas and seasonal groups. This study represents the most comprehensive analysis of prices made to date for this commodity, and establishes basic data regarding supply, demand, and price relationships.

Two manuscripts were prepared for publication during the year:

(1) "Western Lettuce, and Industry in Transition" by O'Dean Hubbard.

(2) "Price Relationships in the Western Lettuce Industry", by R. S. McGlothlin.

4. MARKETING LIVESTOCK FROM ARIZONA RANCHES AND FEEDLOTS.

Project Number: 319. Funds: State. Personnel: R. E. Seltzer.

This project deals with the competitive position of the Los Angeles cattle market. The work is essentially complete and is in manuscript form. Four principal aspects of the Los Angeles market were studied: (1) the institutional structure of the livestock and meat market, (2) the supply area for the Los Angeles market, (3) the structure of prices for cattle and calves and carcass beef at Los Angeles compared to Denver and Chicago, and (4) the future demand for cattle and for beef in this area.

The institutional structure of the market at Los Angeles is probably unique. The importance of direct sales, a large number of important independent packers, highly specialized in their killing operations, and the importance of large food chains as buyers of meat all tend to make Los Angeles different from other markets. A rapidly growing population requires a continuing extension of the supply area of this livestock market.

Manuscript prepared, "The Competitive Position of the Los Angeles Cattle Market", 220 pages.

5. ECONOMIC FEASIBILITY OF THE LOCATION OF ADDITIONAL BEEF PACKING FACILITIES IN ARIZONA.

Project Number: 319 A. Funds: State. Personnel: R. E. Seltzer.

Research in relation to this project is essentially complete. Data regarding meat inshipments are now being brought up-to-date. Other sections of the study have been revised, using 1956 data, and a manuscript is now essentially complete. It is anticipated that the results of this study will be submitted for publication by January, 1958.

The study shows that Arizona's meat packing facilities have failed to keep up with the rapid expansion in the state's population, and as a result, 20 to 25 million pounds of dressed meat are now being imported annually, mainly from Denver and El Paso. At the same time, Arizona produces a surplus of slaughter cattle, shipping approximately 300,000 head out of the state each year. The study further shows that the livestock feeding industry is capable of supporting additional slaughter capacity on a year-around basis. The savings in transportation costs alone would seem to warrant the locating of additional meat packing facilities in Arizona.

Manuscript prepared, "The Economic Feasibility of Locating Additional Meat Packing Facilities in Arizona." 76 pages.

6. IMPROVING LIVESTOCK MARKETING INFORMATION IN ARIZONA.

Project Number: 319 B. Funds: State. Personnel: R. E. Seltzer and T. M. Stubblefield.

Work on this project has developed rapidly this year. Sixty schedules taken from Arizona cattle feeders were tabulated and analyzed. Schedules were mailed to approximately 1,600 Arizona cattle ranchers from which 300 completed schedules were obtained. The results of these investigations were published in Arizona Agricultural Experiment Station Report No. 141.

The reporting of the prices for cattle selling off Arizona ranges was continued during the spring of 1956. This was done to determine if it was feasible to report the sale of range cattle during the spring season. The same procedure was used as that during the fall of 1955. The recipients of these reports were contacted by mail to determine the usefulness of the "Arizona Range Cattle Report." The procedure for making the range cattle market report and the usefulness as indicated by the ranchers, feeders, farmers, and bankers receiving the report, have been published.

Plans for an Arizona Cattle Listing Service have been completed and the usefulness of the Livestock Market News and Related Information has been determined and suggestions for improving these reports have been published.

Publications:

Arizona Agricultural Experiment Station Reports Nos.:
128 "The Need for a Livestock Market News Service in Arizona".
141 "Market News and Related Information Received and Used by Arizona Beef Cattle Producers."
147 "Economic Information Relating to Cattlemen's Production Decisions."
148 "The Arizona Range Cattle Market Report -- An Experiment in Country-Sale Reporting."

Arizona Range Cattle Market Report -- eight weekly issues.

Manuscript prepared, "Evaluation of Livestock Market News in Arizona."

Manuscript prepared: "Plans for an Arizona Cattle Listing Service."

7. CONSUMER ACCEPTANCE OF BEEF.

Project Number: 373. Funds: State and Title II. Personnel: R. E. Seltzer and George Campbell.

During 1956 a series of controlled experiments relating to consumer acceptance of beef of varying quality was conducted in Phoenix, Arizona. The results of this controlled experiment substantiated the results obtained in an earlier household survey made in the same area. The preference for lean beef, for a bright red color, and for white fat was again demonstrated. Consumers' lack of knowledge of beef grades was again demonstrated.

Publications: Arizona Agricultural Experiment Station Report 145, "Consumer Acceptance of Beef". A Controlled Retail Store Experiment.

8. RESOURCE REQUIREMENTS, MANAGEMENT PRACTICES, AND MEASURE OF EFFICIENCY IN FEEDLOT OPERATIONS.

Project Number: 381. Funds: State. Personnel: Andrew Vanvig.

Detailed records were obtained on 65 individual lots representing 18,400 head of cattle and calves fed during the 1955-56 feeding season. These records were summarized in a report covering cattle feeding costs for four of the common classes of cattle fed in Arizona. These include (a) Hereford steers, (b) Hereford heifers, (c) Brahman-Cross steers, and (d) Brahman-Cross calves. For each group such factors as length of feeding period, starting and finishing weights, rate of gain per day, pounds of feed consumed per pound of gain, and cost per 100 pounds of gain were calculated.

Attention was also given to the importance of feeder-slaughter margins to successful cattle feeding. A formula was devised to determine necessary margin based on initial weight of feeder, cost of gains, and expected sale price of the finished animal. This work is reported in the Fall 1956 issue of Progressive Agriculture.

9. EFFICIENCY IN THE HARVESTING AND USE OF SEEDED FORAGE CROPS.

Project Number: 387. Funds: State and Regional Research. Personnel: J. C. Headley.

The work in the past year has been concentrated on the determining of variable costs for the various methods of harvest. Items such as the cost of labor, grease, fuel, and repairs required for the various machines. This has been done on a case study approach basis, with the researcher working rather closely with the farmers actually doing the various jobs throughout the 1956 season. This has given rates of operation and the resulting costs and amounts of inputs used. This work was done exclusively in the Salt River Valley of Central Arizona for reasons stated in the previous year's report.

By surveying dealers of farm equipment and through interviews with farmers, a schedule of the number, types, and the investment required for new machines under five (5) different forage harvesting situations has been made.

A mail questionnaire was mailed out to dairymen and cattle feeders in the Salt River Valley, whereby it was learned what proportions of the total use was harvested by a particular method and what method or methods were associated with the different livestock enterprises.

A set of COST BUDGETS, based on the case studies, are being formulated for the different operations and methods of harvesting forage in Arizona. This will give a picture of the relative costs of the various methods of harvesting forage crops.

10. THE EFFECTS OF FIRES ON COTTON GINNING COSTS AND POSSIBLE MEANS OF REDUCING FIRE LOSSES IN ARIZONA.

Project Number: 392. Funds: State and Regional Research. Personnel: Norman E. Landgren.

A survey of gin equipment was made during the past year to obtain data which were used in selecting the sample of gins from which fire reports were obtained and which will be used in relating cotton fire loss to gin equipment. These data were obtained from 107 of the 121 short staple gins in the state.

A sample of 89 gins, representing installations of different fire preventive devices, was selected for the fire reporting phase of this study. Personal visits were made to these gins to solicit their cooperation in reporting certain information on all cotton fires occurring in and around the gin during the 1956 season. As of December 15, 1956, 468 fires resulting in the following losses had been reported: Machinery, $1,555.00; cotton, $180,126.91 and value of ginning time lost, $4,522.23. Of these 468 fires, 107 resulted in damage in excess of $100 and 361 in damage below $100.

11. MARKET POTENTIAL FOR PIMA S-1 COTTON.

Project Number: 412. Funds: State and Regional Research. Personnel: Norman E. Landgren.

This project was initiated on July 1, 1956. An organizational meeting was held at State College, New Mexico on November 8, 1956. At this meeting tentative procedures to be used were formulated. Arrangements were made to request the informal cooperation of the Agricultural Marketing Service in achieving the objectives of this study. This cooperation has been assured. Some work compiling historical data on supply and disappearance of American-Egyptian cotton was done during 1956.

12. ECONOMICS ADJUSTMENTS IN THE ARIZONA DAIRY INDUSTRY.

Project Number: 413. Funds: State and Regional Research. Personnel: O'Dean Hubbard.

The Arizona Station became active in WM-15, July 1, 1956, and since that date basic data on the dairy industry of the state has been compiled. This data was deemed necessary before undertaking any study of the state's dairy industry.

Schedules have been prepared and partially completed by producers and processors. These schedules are a source of basic information relative to the industry of the state. From 578 schedules mailed to producers, 129 were returned completed or 22.32 per cent. This response took three mailings, spaced one month apart. A random sample of the non-respondents has been drawn and personal interviews are now in process. A report is being prepared from the questionnaire returned by producers. The questionnaire to processors has not been returned as rapidly as at first hoped. However, each processor has been contacted again and all have consented to speed up the completion of schedules.

A map is being prepared to delineate areas of demand and supply with the areas of limited and surplus supplies being outlined. A graduate student (Wayne Blewer) is gathering data to prepare a thesis on "The Dairy Industry of Arizona and Its Characteristics." The data being compiled is largely historical and from secondary sources.

Manuscript prepared: "Some Economic Adjustments in the Arizona Dairy Industry."

13. ORIGIN, MOVEMENT, DISPOSITION, AND FINAL MARKET GRADES OF MEXICAN CATTLE IMPORTED INTO THE UNITED STATES.

Project Number: 414. Funds: State and Title II. Personnel: R. E. Seltzer and T. M. Stubblefield.

This project began July 1, 1956. Since that time complete monthly data for the period 1921-1956 covering importation of Mexican cattle into the United States through each port-of-entry have been assembled and analyzed, by port-of-entry and destinations in the United States.

Detailed data concerning importations by class, weight, origin in Mexico, import and export duties paid, purpose for which imported, means of transportation, etc., have been assembled for cattle imported through Nogales and Naco, Arizona. This data is now being collected for the other Arizona ports as well as for locations in Texas, New Mexico, and California.

A sample of current inshipments is being accumulated and detailed information on costs of marketing, transportation, prices, and performance of these cattle will be collected and analyzed.

14. ECONOMICS OF MARKETING HAY AND FEED GRAINS IN ARIZONA.

Project Number: 415. Funds: State and Regional Research. Personnel: R. S. McGlothlin.

Work was begun on this project in Arizona on July 1, 1956. Since that time considerable work has been done on "descriptive" phases of the project. Complete records of truck movements of hay and grain into California, the largest feed-deficit area in the West, have been accumulated for the period July, 1953 to July, 1955. These records have been tabulated and summarized by IBM, relative to the sources of feed shipments and other relevant data, and will be used in a forthcoming manuscript.

A survey of a majority of the feed dealers in the state was undertaken. This survey dealt with seasonal and annual volumes, sources of supplies, destination of sales, and certain other data. Those data will be tabulated by IBM and included in a manuscript to be prepared early in 1957.

Finally, a survey was made of our growing cattle-feeding industry to determine the relative amounts of hay and feed grains which are produced by the feeder, purchased from other producers, and purchased from feed dealers. Information was also obtained concerning the relative prices of various supplies. This information will also be included in the above-mentioned manuscript.

15. ECONOMICS ANALYSIS AND EVALUATION OF THE USE OF FIBER TESTS IN THE MARKETING OF COTTON.

Project Number: 426. Funds: State and Regional Research. Personnel: Norman E. Landgren.

This project was activated on July 1, 1956. The Arizona Experiment Station took an active part in developing plans for the conduct of the regional study and in the development of the cotton shipper's schedule which will be used to obtain information on the nature and extent of the use of fiber testing instruments and costs associated with their use.

Department of
AGRICULTURAL ENGINEERING

1. GROUNDWATER STUDIES.

Project Number: 1. Funds: Hatch and State. Personnel: H. C. Schwalen, R. J. Shaw, and K. R. Frost.

UPPER SANTA CRUZ VALLEY

Collection of data was continued in the area from Red Rock to Nogales and Sasabe. Most of the work was carried on with the support of Pima County and the City of Tucson cooperative project. Annual water level measurements were made on an intensive basis. Some 1500 wells were visited. The measurement of water levels in a representative group of wells was made about once a month.

Santa Cruz County

The year 1956 was dry both winter and summer. As a result, there was a recession of water level to about that of 1953. There was little stream flow below Calabasas and there was a slight increase in acreage. North of Tubac there was slightly less lowering of the water table than in the vicinity of Calabasas. Probably, the ground water reservoir is wider and therefore there is more stored water to smooth gains and losses somewhat.

Sahuarita-Continental District

The lack of recharge in 1956 was more acutely felt here than farther upstream. The losses running from 4 to 20 feet in individual wells and averaging about 7 feet. This is due to the lack of recharge and an unusually large acreage of winter crops which kept the wells operating during the normal season of recovery.

During the year 1956, the City of Tucson began pumping from its group of wells in the north end of the Sahuarita district. However, no effect of this pumping on the rest of the basin could be found. Actually, the City pumped relatively little water.

Tucson Area

There was a normal loss of ground water during the year 1956 in area southwest of Tucson. The excessive build up of 1955 was drawn on rather heavily and losses of six to ten feet were the rule in most wells. The water table receded to about that of 1951.

West and northwest of the city there was a rather severe loss of six to eight feet of water. The development of more subdivisions east of the city results in heavier pumping and a continuous loss in the water table. The rate of loss is also increasing east of Tucson. The area along the Rillito Creek-Tanque Verde Wash area was hard hit with some wells being almost dry. This is not new for this area, however, and it will be restored by good winter runoff.

Cortaro District

The Cortaro District between Rillito Creek and Rillito Station was not overpumped during 1956. The ground water level remaining substantially unchanged from that of the preceding four years. The lowering under the mesa lands to the east continued. There was little or no recharge from the Canada del Oro in 1956.

AVRA-ALTAR VALLEY

Red Rock District

The severe unwatering of the Eloy Area is extending into the Red Rock District. The pumping north and east of Red Rock Station has created a sink in the ground water table. The loss in ground water between Marana Air Base and Picacho Peak was unusually severe, averaging 17 feet for the area.

Marana Area

The shift of pumping for this district from the Cortaro Area into the Marana district combined with the private pumping in the same area resulted in the continued loss of ground water in this area. The loss average was 6.7 feet.

Anway District

Between the Papago Indian Reservation and the Marana Area there is some scattered irrigation. This has resulted in a loss of about 6 feet per year in the water table. 1956 was no exception.

Upper Avra Valley

South of the Papago Indian Reservation there is a limited area of farming. There has been a continuous loss in water level since this area was developed. The loss in 1956 was slightly less than expected. Possibly there was some recharge in 1955 which reached this area during 1956. The loss has been 17 feet since 1951.

Three Points Area

Above the Avra Valley, at the north end of the Altar Valley, is a very small irrigated area which is not over-developed and in which the water table reflects the recharge. There was a slight loss in 1956 attributable to the poor rainfall.

LITTLE CHINO VALLEY

The winter of 1955-56 was exceptionally dry in this valley requiring intermittent pumping early in the season. At the time water-level measurements were made the water table had receded far beyond the point of normal lowering. In the north end of the valley the lowering was 5 to 7 feet where annual lowering in previous years had been 2 to 3 feet. Pumping had only a slight affect on the levels in the south end of the valley where pumping was light.

2. THE PRODUCTION AND UTILIZATION OF TAMARISK, TAMARIX ARTICULATA.

Project Number: 231. Funds: Hatch and State. Personnel: K. R. Frost.

Preservative treatment of tamarisk fence posts

The annual inspections of treated posts, most of which are set in fence lines, were made March 21, 1955 and February 6, 1956. The results of the inspections are:

a. Of the 25 posts treated at West Oakland, California, and set in the ground in the spring of 1935, in four locations, 12 posts in the railroad right-of-way fence, all in sound condition, were destroyed inadvertently by reconstruction operations; of seven posts at Kinne ranch, five were lost by a change in ownership and two failed due to fungi; of the six on University Farm, three failed and three are still sound.

b. Of the 141 posts set in the Kinne east fence line in the fall of 1935, two posts failed in the 1954 season, both treated after drying and after the 1955 year there were four new failures, two green-treated and two dry-treated. During the 1956 year seven green-treated and three dry-treated posts failed. The total number of failures is now 62, 32 green-treated and 30 dry-treated. The average life is expected to be about 25 years and there is no advantage in drying the posts before treatment.

c. 101 posts were treated with various preservatives in 1942. Of the 50 posts set on the Trowbridge-Page range land, one post treated, dry, with wood-tar creosote failed in 1954. In February 1956, ten new failures were found, as follows: six posts treated with wood-tar creosote, three when green and three when dry; one post treated with pentachlorophenol, green and three treated with coal-tar creosote, two green and one dry. Previously there had been only three failures, all wood-tar. Inspection on December 17, 1956, resulted in only one failure which was wood-tar (dry) treated. It appears that posts treated with pentachlorophenol or coal-tar creosote will have a satisfactory long life in the range-land soil, probably 20 years or more. The duplicate posts, 51 in number, set in rich alluvial soil on the University Farm and subject to repeated irrigations have shown a much shorter life. The posts treated with wood-tar creosote had an average life of five years for the posts treated dry and seven years for the posts treated green. The new failures in 1954 were a wood-tar post treated green, the last post of that group and the posts treated with pentachlorophenol one green and one dry and three posts treated with coal-tar creosote, two green and one dry, a total of 8 posts. The failures in 1955, as found on February 5, 1956, were six in number, all treated with coal-tar creosote, four green and two dry. No new failures occurred during the 1956 season. It appears therefore that the average length of life in that unfavorable soil environment is only about twelve or fourteen years. The check posts that were set in the same fence line without any treatment lasted an average of two and one-half years.

Of the five posts treated with zinc-chloride, two of the three on the University Farm have failed. The other two posts on the Page ranch are still sound.

3. MECHANIZATION OF COTTON PRODUCTION AND HARVESTING.

Project Number: Hatch 269. Funds: (Bankhead-Jones 9b 1, 2, 3) and State. Personnel: H. C. Schwalen and M. D. Cannon.

The 1956 investigations included cultivation treatments, variety-harvesting tests in upland cotton, picking efficiency tests in upland (A-44) cotton, harvesting-ginning tests, plant population-harvesting studies in American-Egyptian (S-1) cotton, and a preliminary evalution of a new suction-type harvester.

The cultivation studies included (1) Check, using regular cultivation methods with sweeps and disks, (2) Regular cultivation plus flaming, (3) Regular cultivation plus flaming plus weeder rods and (4) Regular cultivation plus weeder rods. No differences were found in either yield or quality. Weed counts in the field, however, showed that the supplementing of regular cultivation with flaming and/or weeder rods gave a highly significant difference in weed kill.

Two weed counts, taken in a five-inch band on both sides of the drill row before and after cultivation, gave the following percentages in weed kill:

(1)	Check	76.2%
(2)	Flaming	91.6%
(3)	Flaming plus weeder rods	94.6%
(4)	Weeder rods	90.2%

Variety-harvesting tests were conducted on eight upland varieties to determine the adaptability of each to mechanical harvesting. One late season picking with a single row broached spindle picker gave the following field harvesting efficiences: 1517C - 96.06%; 44WR - 95.67%; 4-42 - 94.76%; 504 - 94.32%; 124-6-66 - 93.16%; 124-68 - 93.83%; 49-2 - 95.64% and A-44 - 94.45%.

A comparison of hand picking to harvesting with a single-row broached spindle picker in A-44 cotton showed a 4.02% advantage in field harvesting efficiency in favor of hand picking. There was no apparent difference in quality.

In cooperation with the U.S.D.A. ginning laboratory at Mesilla Park, New Mexico, harvesting-ginning investigations were conducted with Pima S-1 cotton. With hand picking used as a check, three machines were used, (1) broached spindle, (2) fluted spindle and (3) smooth spindle. The average hand picking efficiency was 91.42%; machine picking effieiences were as follows: (1) Broached spindle - 86.66%; (2) Fluted spindle - 82.55% and (3) Smooth spindle - 83.66%. Only one picking was done in each case.

Results from the ginning laboratory have not yet been made available.

Plant population-harvesting studies were also made in American-Egyptian cotton. Three different plant populations were used: 9,800, 15,700 and 26,000 plants per acre. The plots were harvested once with a broached spindle picker. Machine picking efficiencies were as follows: Low population, 92.25%, Medium population, 93.14% and High population, 94.33%.

Preliminary investigations were made on the Burdette Suction Harvester at Sacaton, Arizona, in A-44 cotton. Field harvesting efficiency was quite high, averaging 95.77%. Lint turnout averaged 40.4%. The U.S.D.A. grade for each of four replications was SLM due to cracked seed in the samples. The picking rate was not as high as expected, averaging only 28.3 pounds of seed cotton per hour.

4. SPRINKLER IRRIGATION STUDIES UNDER ARID SOUTHWESTERN CONDITIONS.

Project Number: 303. Funds: Hatch and State Research. Personnel: K. R. Frost and H. C. Schwalen.

A field of 7½ acres of alfalfa was used for sprinkler studies by irrigating with four different treatments: (1) frequent sprinkled, (2) regular sprinkled, (3) night sprinkled, and (4) flood irrigated. All irrigations except the frequent treatment were applied as required by the appearance of the crop. Sprinkling rates generally varied from .15 to .2 inches per hour.

The frequent treatment was irrigated daily beginning 5 or 6 days after each alfalfa cutting. Sprinkling periods were for 4 or 5 hours, during the hottest part of the day. Regular sprinkled plots were irrigated for periods of 7 to 8 hours during the day. Night sprinkled plots were irrigated by 12-hour applications from 6:00 p.m. to 6:00 a.m.

Flooded plots were irrigated as indicated by crops appearance generally at 6 to 8-day intervals. Applications were uniformly applied by pipe at rates the soil would readily absorb and usually resulted in depths of 4 to 5 inches per irrigation.

Table I shows that the yield per acre-foot of water applied was greatest for regular sprinkled plots but the highest yield per acre was obtained for frequent and night sprinkled plots. The flooded plots produced a poor crop and also required the highest total water application. Night applications were found to be too high resulting in percolation losses though considerably less water was applied than for the flood irrigated plots.

Results for one year indicate that the crop yield per unit of water applied is about the same for the variations of sprinkling time and periods used in these tests if the crop is not allowed to be visibly stressed.

Treatment	Seasonal Yield T/Ac. July 1 to November 1, 1956	Total Application Acre Ft. per Acre	Yield in Tons per Acre Foot	Average Applied Depth Inches per Day	Pounds of water to produce one Pound of Dry Matter
Frequent sprinkled	3.42	2.50	1.37	.29	1040
Regular sprinkled	3.04	2.16	1.40	.22	1030
Night sprinkled	3.36	3.24	1.04	.32	1430
Flooded	2.66	3.62	.73	.36	2270

5. HYDROLOGY AND WATER UTILIZATION OF SMALL DRAINAGE AREAS ON THE VALLEY SLOPES IN SOUTHERN ARIZONA.

Project Number: 375. Funds: Bankhead-Jones 9b, 1 & 2, and State.
Personnel: H. C. Schwalen and D. A. Woolhiser.

Rainfall and runoff measurements were continued on an 18 square mile study area located 10 miles each of Tucson, (see Figure 1). A critical depth flume was completed and water level recorders were installed on three reservoirs.

Rainfall

The total rainfall catch in the 29 rain gages varied from 4.77 inches to 9.57 inches for the 1956 calendar year. The arithmetic average rainfall was 7.18 inches, 66% of the 63 year average at the University of Arizona. The Thiessen average was 7.30 inches. It is interesting to note that the lowest rainfall for a single rain gage recorded during 1956 was 0.49 inches less than the record low rainfall at the University of Arizona gage.

The distribution of annual rainfall is shown on the isohyetal map (Figure 2). The variability of the rainfall illustrates that in this area records from a single rain gage may not be representative of the average rainfall over an area near the gage.

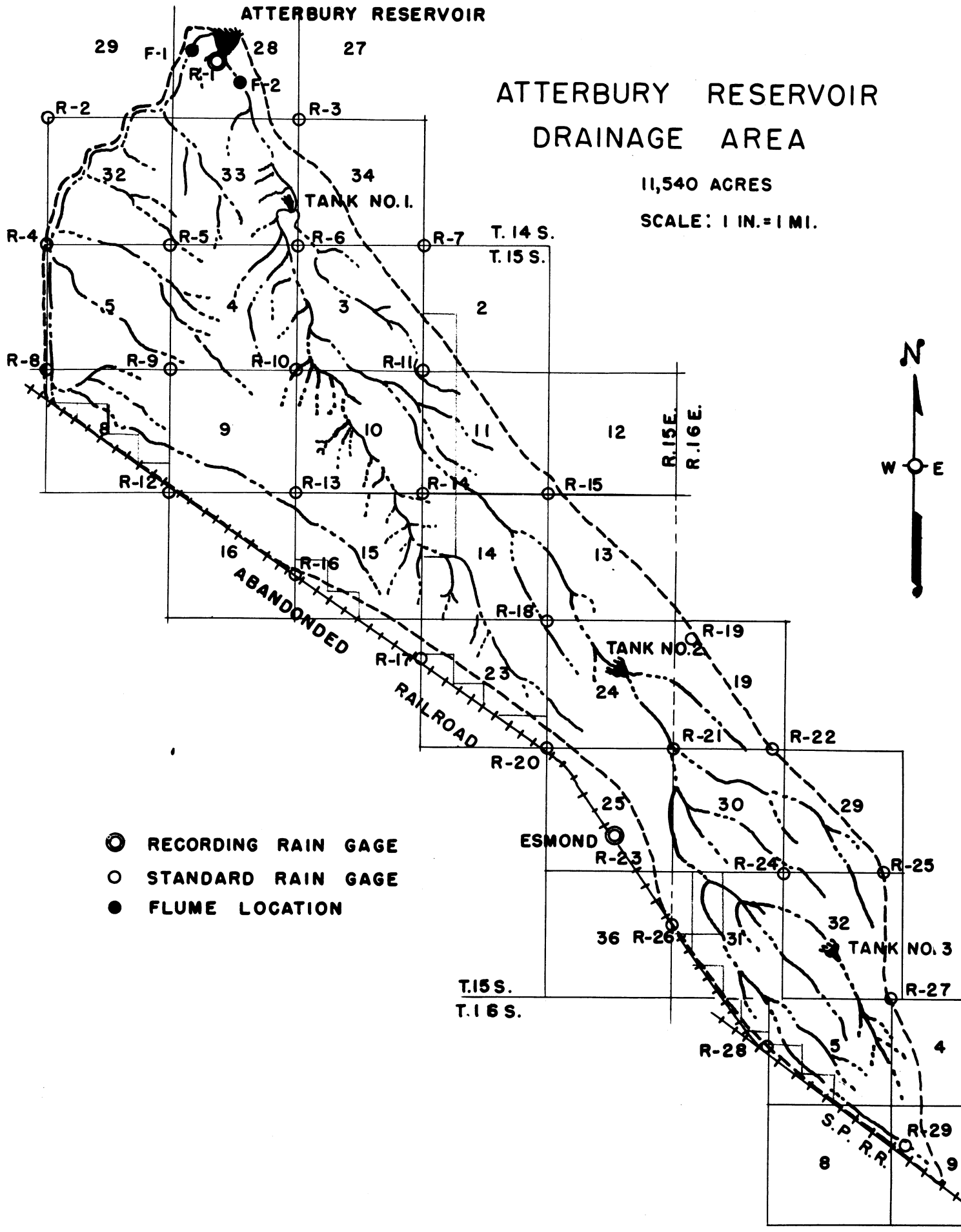
The rainfall records are being analyzed to determine areal extent of excessive rainfall. After several years of record, this data should prove valuable for storm drainage investigations in this area.

Runoff Yield

There were only three runoff producing storms in 1956. These storms occurred in July and August and provided a total runoff of 248 acre-feet or 13.7 acre-feet per square mile. This quanitity may also be expressed as 0.21 inches, 2.98% of the average rainfall. A summary of runoff collected in the reservoirs is shown below. Evaporation loss was calculated by the use of corrected land pan evaporation rates:

	Atterbury Reservoir	Tank No. 2	Tank No. 3	Total
Total runoff (Acre-Feet)	210	31.0	7.0	248
Evaporation loss	33	4.3	1.1	38
Percolation	173	26.3	5.8	205
Storage, December 31, 1956	4	0.4	0.1	4.5

The quantity shown as percolation includes deep percolation to ground water and soil moisture storage. Part of the water stored in the soil is transpired by vegetation growing near the reservoirs and part is evaporated from the soil surface.


ATTERBURY RESERVOIR
ATTERBURY RESERVOIR
DRAINAGE AREA
11,540 ACRES
SCALE: 1 IN. = 1 MI.
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W
E
TANK NO. 1.
TANK NO. 2
TANK NO. 3
ESMOND
ABANDONED RAILROAD
S.P. R.R.
T. 14 S.
T. 15 S.
T. 15 S.
T. 16 S.
R. 15 E.
R. 16 E.
F-1
F-2
R-1
R-2
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RECORDING RAIN GAGE
STANDARD RAIN GAGE
FLUME LOCATION

Department of
AGRONOMY AND RANGE MANAGEMENT

1. THE RANGE RESOURCES OF ARIZONA.

Project Number: 232. Funds: Hatch. Personnel: R. R. Humphrey.

Work initiated the previous year in a bulletin to include Pima and Santa Cruz counties was continued. The data being collected include (1) range forage types, (2) range condition on each type, (3) photographs of the various types and condition classes, and (4) the forage value of principal species.

2. THE CONTROL OF WEEDS ON IRRIGATED LANDS.

Project Number: 261. Funds: Hatch. Personnel: K. C. Hamilton, (H. F. Arle and G. N. McRae, A.R.S. Collaborators), D. C. Aepli, L. C. Chapman, E. H. Hussmann, F. Pritchard, R. K. Thompson, and D. Cannon.

Monuron and Diuron applied at cotton layby gave excellent control of annual weeds for the remainder of the growing season. The rate of application must be varied with soil type. The effect of herbicide residues on succeeding grain crops varies with soil type and method of seedbed preparation. Diuron appears safer than monuron for use in cotton. NPA sometimes controlled annual grasses, however, applications at the first and second irrigation stunted cotton. Spot applications of Dalapon show promise for controlling established Johnson grass in cotton.

The effectiveness of soil injections of chlorophenoxy herbicides as growth regulators in cotton was influenced by soil type. In one test 2,4-D applied at 1.0 pounds per acre, at the first irrigation increased yield. On sandy soils the rate must be decreased; on heavier soils a higher rate may be needed.

Diuron has shown promise for the control of annual weeds in alfalfa, sorghum, soybeans, and Bermuda grass.

Established Johnson grass on ditchbanks was controlled with the following treatments: 2-3 applications of dalapon after mid-summer, L. P. flaming at 2 week intervals for the entire growing season, and chlorate or chlorate borate and/or urea soil sterilants applied before the summer or winter rains.

3. COTTON PRODUCTION UNDER IRRIGATION

Project Number: 264. Funds: Hatch. Personnel: W. D. Fisher, R. E. Briggs, Edna Lewis, L. Patterson, D. C. Aepli, F. Pritchard, L. C. Chapman, and C. W. Fitzgibbon.

A. In the upland variety trials, two new advanced strains outyielded all other entries in three out of four tests.

B. Skip row planting at two locations resulted in 17% and 40% increased yield over solid planting. When soybeans were interplanted with cotton in alternate 4-row strips, the yield of cotton was essentially the same as solid planted cotton.

C. Papago peas continued to be the best green manure crop preceding cotton. However, nitrogen applied to the cotton in amounts equal to that supplied by the peas gave equally good cotton yields.

D. A spacing test under heavy verticillium wilt conditions showed increased yields with closer spacings in a range of 6"-18".

E. In a variety test under severe verticillium wilt, 4 varieties outyielded A-44. Yield differences among the top 4, which included 44 WR, were not significantly different.

F. Pima S-1 outyielded Pima 32 and yielded as much as any hybrid of the two varieties.

G. In a spacing - irrigation - fertilization test, yield differences were masked by soil variability. However, close spacing (2") resulted in a significantly higher yield than wide spacing (14").

4. CONTROL OF NOXIOUS SHRUBS ON SOUTHWESTERN RANGES. I. CHOLLA AND PRICKLY PEAR CACTUS (OPUNTIA SPP.). II. BURROWEED (APLOPAPPUS TENUISECTUS).

Project Number: 285. Funds: Hatch. Personnel: E. M. Schmutz, R. M. Turner, B. L. Branscomb.

I. Cholla and Prickly Pear. A thermo-mechanical method of control is being studied. Cholla and prickly pear are handchopped semimonthly. Daily rainfall, semimonthly soil samples, continuous temperature and relative humidity measurements are recorded. Late spring and late summer sprouting counts will be made to correlate cold, heat and soil moisture with joint survival.

II. Burroweed (Transferred to Regional Research 366).

III. Oak Chaparral. Eight herbicides were tested on fire sprouts of turbinella oak near Dewey at 1 to 3-month intervals for one year following a June burn in 1955. Best results were obtained beginning six months after the June burn, when foliage was well developed and winter rains had begun. The most effective herbicides and their greatest topkill were 2-(2,4,5-TP), 80 per cent; 2,4,5-T ester, 65 per cent; 2-(2,4-DP), 55 per cent; and 2,4-D ester, 45 per cent. The other chemicals including 2,4,5-T amine; ATA:a 2:1:1 mixture of Dalapon; 2,4-D:2,4,5-T; and 2,4-D amine gave less than 25 per cent topkill. There was practically no complete kill of individual plants.

IV. Creosotebush, Whitethorn and Tarbush. A two-year study on the control of these shrubs at two locations gave high total kill, when sprayed with heavy rates of 2,4,5-T ester. Kills of 85 to 100 per cent were obtained on whitethorn and tarbush and 65 to 85 per cent on creosotebush. Peak kills were obtained during August and September, March and April, approximately 30 days after summer rains or spring growth began. The herbicide caused some damage to grasses, but recovery was rapid.

5. FACTORS AFFECTING THE NOXIOUS SHRUB CONTROL PROGRAM ON ARIZONA RANGELANDS - 1. EFFECTS OF SHRUB CONTROL ON FORAGE PRODUCTION.

Project Number: 292-I. Funds: Hatch. Personnel: D. G. Wilson.

No measurable growth occurred during the period of observation due to insufficient rainfall. Approximately 3.00 inches of rain were recorded for the entire year, with 1.90 inches falling in one storm on August 28, 1956. This latter storm contributed very little to the drought-stricken vegetation.

6. FACTORS AFFECTING THE NOXIOUS SHRUB CONTROL PROGRAM ON ARIZONA RANGELANDS. - III. DETERMINANTS OF SITE POTENTIAL FOR SHRUB INVASION.

Project Number: 292-III. Funds: Hatch. Personnel: D. G. Wilson.

No data secured due to extreme drought conditions. A rather thorough review of literature was made in order to correlate possible results of this study with work in other areas.

7. SEED PRODUCTION OF FORAGE PLANTS.

Project Number: 304. Funds: Hatch. Personnel: D. F. McAlister, N. Wright, C. O. Stanberry, F. E. Todd, D. M. Tuttle, F. Pritchard.

Four inbred lines of pearl millet developed at the Georgia Agricultural Experiment Station were tested for seed production potential at the Tucson, Mesa and Yuma experimental farms. Sufficient seed of each of the lines was produced for a commercial planting of 10 acres of the hybrid from these inbreds in 1957. A small amount of hybrid (F_1) seed was produced at Tucson which will be used for forage evaluation studies in the southeastern states in 1957.

A study of the effects of cultural practices on seed production of African alfalfa is in progress at Yuma. There were no differences in seed production of plants grown in broadcast stands versus those grown in 24-inch rows in 1956. The row spacings will be progressively increased so that in 1958 seed production comparisons will be possible between solid, 24-, 48-, and 96-inch spacings. A plant density study using individually spaced plants was initiated in 1956 and seed production comparisons will be possible in 1957.

8. THE IMPROVEMENT AND CULTURE OF SMALL GRAINS.

Project Number: 305. Funds: Hatch. Personnel: A. D. Day, D. C. Aepli, F. Pritchard, E. H. Hussmann, L. C. Chapman, R. K. Thompson, G. D. Massey, and H. E. Jacka.

Variety yield tests of barley, wheat, and oats were grown at three locations in Arizona: Yuma, Mesa, and Safford, in an effort to select adapted varieties for these three areas. At Yuma, Arivat and California Mariout barley, Awned Onas wheat, and Ventura oats were the high yielding grain varieties. Arizona Sel. 615 barley, Onas 53 wheat, and Alamo oats were the high yielding grain varieties at Mesa. At Safford, Harlan barley, Kenya/Lemhi-4 wheat, and Ventura oats were the high yielding grain varieties.

A malting barley variety test, including varieties from all over the United States and Canada, was grown at the Mesa Experiment Station to investigate the possibility of growing malting barley in Arizona. Atlas 46 and Atlas 54 were the high yielding malting barley varieties in this test.

Foundation seed of the small grain varieties now being certified by the Arizona Crop Improvement Association was grown on the Agricultural Experiment Stations at Yuma, Mesa, and Safford.

The Arivat barley purification project was completed and a new supply of "Breeder Seed" was grown at the Mesa Experiment Station.

A breeding nursery was grown at the Tucson Experiment Station and several crosses were made in an attempt to incorporate some of the desirable characteristics of unadapted varieties into our recommended Arizona varieties.

9. POISONOUS PLANTS IN ARIZONA.

Project Number: 328. Funds: State Research Only. Personnel: David G. Wilson.

Funds for reactivation of this project were not available until after July 1, 1956. Collections of poisonous plants from Arizona ranges are being made. When sufficient information is available on distribution and prevalence of the various plants poisonous to livestock in Arizona, a bulletin will be prepared in cooperation with the Animal Pathology Department for use by Arizona stockmen.

10. ASPHALT PAVED RUNOFF BASINS AS A SOURCE OF STOCK WATER ON SEMIARID RANGES.

Project Number: 330. Funds: State Research Only. Personnel: E. M. Schmutz, R. J. Shaw.

Observations were continued at the Page Ranch on the durability of asphalt for paving runoff basins and on the relationship between precipitation and water storage for livestock and wildlife.

On the Vaca Ranch a similar project is being set up to test the durability and effectiveness of vinyl plastic film for paving runoff areas and as a covering to reduce evaporation of water to be used for livestock consumption. To date a reservoir and runoff area has been constructed and lined. A water stage recorder and automatic rain gauge is being purchased to study the relationship between precipitation, runoff, evaporation and water consumption.

11. ALFALFA IMPROVEMENT.

Project Number: 341. Funds: State Research. Personnel: M. H. Schonhorst, D. F. McAlister, D. C. Aepli, F. Pritchard, H. Czajkowski, L. C. Chapman, E. Hussmann; M. W. Neilson, V. D. Roth.

(a) Large-scale fall plantings of African alfalfa were made at the Mesa and Yuma farms to coincide with heavy fall and winter infestations of the spotted alfalfa aphid. A large percentage of the surviving seedlings are expected to be highly resistant. The second phase of testing, antibiosis tests, are being conducted currently. Resistant plants will be increased vegetatively and planted in Arizona and California. Seed from these plantings will be used for further testing and increase.

(b) Seed of approximately 50 alfalfa varieties and introductions was planted to determine varietal reaction, as seedlings, to the spotted alfalfa aphid. Insect populations were sufficiently high to give considerable contrast among varieties. Reaction of alfalfa varieties provides state and federal plant breeders with information concerning the most suitable source of resistance for their particular region.

(c) Six alfalfa variety tests for hay production were established at the Mesa, Safford, Tucson and Yuma experimental farms. Seven northern and 13 southern varieties were included. Hay yield data of 1956 corroborated previous information concerning the superiority of African for southern Arizona.

12. CHANGES IN THE DESERT GRASSLAND -- AN ANALYSIS OF CAUSES.

Project Number: 365. Funds: Regional Research (W-25). Personnel: R. R. Humphrey, C. W. Ferguson.

A. Vegetational changes on the Jornada Experimental Range in southern New Mexico were analyzed to determine changes within the period of historic record and the reasons for these changes. The study indicates 28 per cent of the original grassland is now dominated by shrubs, largely honey mesquite. This shrub has increased its original acreage by 107 per cent. Climatic cyclic changes may have favored shrub invasion. Grazing pressure has favored the increase of shrubs. Uncontrolled fires were formerly a factor in restricting the spread of shrubs.

B. The study of annual rings of woody species in the desert grassland has been continued. This has been enlarged to include species of Artemisia from northern Arizona and elsewhere in the West. Results to date indicate that most of the desert grassland shrubs possess indeterminate rings that are hard to date with accuracy.

C. The analysis of literature designed to determine historical changes in desert grassland vegetation has been essentially completed. A manuscript is ready for final typing. Principal conclusions are that grazing by domestic livestock, plant competition, rodents and fire suppression have all affected a conversion from grass to brush. Fire suppression is the one major factor that has been largely responsible for the change. Although extensive changes have occurred, widespread brush-covered areas that have commonly been assumed to have at one time been grass, were in brush at the time of first white settlement.

13. THE RELATIONSHIP BETWEEN FREE AUXIN CONTENT AND SUSCEPTIBILITY OF NOXIOUS PLANTS TO CONTROL BY CHEMICALS.

Project Number: 366. Funds: Regional Research (W-11).
Personnel: E. M. Schmutz, B. Branscomb, R. M. Harris, F. H. Tschirley, H. M. Hull.

The formerly successful method of auxin extraction and purification based on Kefford's liquid partitioning process proved erratic for burroweed and mesquite plant extracts. Continued attempts to stabilize the method have been fruitless. Other purification methods and their combinations being tested include electrophoresis, paper chromatography, dialysis and tannic acid precipitation.

The rapid freezing technique for the extraction of free auxin from the plant tissue, using dry ice in absolute ethanol, and the sensitive avena coleoptile test, to measure the free auxin, appear satisfactory.

The cooperative field study, with the Agricultural Research Service, Field Crops Research Branch, which is a part of this project, is at a standstill pending development of a reliable method of purification.

14. THE EFFECT OF PHYSIOLOGICAL AND ENVIRONMENTAL FACTORS ON ALFALFA SEED PRODUCTION.

Project Number: 367. Funds: Regional Research (W-23).
Personnel: D. F. McAlister, C. O. Stanberry, F. E. Todd (ARS), N. R. Crawford.

The following information was obtained in the field study at Tucson of the effect of day length on Ranger and Vernal alfalfa. Highly significant differences were observed between clones in both varieties in number of days between clipping and the appearance of first flower, seed production, dry weight of plants and plant height. Long days resulted in a decrease of the number of days to flowering in both varieties, and a decrease in both plant height and weight in Vernal. While the data did not show a significant photo-periodic response in seed production within varieties, there was a significant interaction between clones and day length in Ranger and Vernal. Of the clones in each variety showing response to day length, the majority produced greater amounts of seed under long days.

At Yuma no differences could be detected in root reserves or seed yields between plots clipped 1, 2 or 3 times prior to turning to seed. In addition to chemical analysis of root samples and seed yields, measurements were taken on forage yield, stem height, seed size, seeds per pod, seed pods per raceme, racemes per stem, bracts per raceme and stems per unit area. Of the above plant characteristics the only one affected by the cutting treatments was forage weight. Two and three cuttings prior to turning to seed significantly reduced forage weight compared with one clipping.

15. SEED INCREASE AND PRELIMINARY EVALUTION OF PLANT INTRODUCTIONS THAT MAY BE SUITED TO THE SOUTHWEST.

Project Number: 368. Funds: Regional Research (W-6).
Personnel: L. P. Hamilton, R. R. Humphrey.

About 200 lines of forage grasses and legumes have been planted for observation of seedling vigor, growth type and rooting habits, seeding habits, heat and cold resistance, forage volume and adaptability to moderately high soil pH. Seed was obtained from about twenty lines and plantings established to produce seed from about twice this number. One hundred lines of beans were observed for disease resistance, commercial qualities or green manure value.

Several lines of grasses and legumes have been found which merit further study.

16. THE INFLUENCE OF CLIMATIC FACTORS ON FIBER PROPERTIES IN COTTON.

Project Number: 380. Funds: Hatch. Personnel: W. D. Fisher, R. E. Briggs, and Edna Lewis.

1. A comparison of fiber properties of 8 varieties of cotton grown at 4 locations showed: (a) Strongest fiber was produced at Yuma becoming weaker at the other locations with increasing elevation. (b) Fiber strength was lower at all locations with the second picking. These differences are associated in part with differences in temperature; fiber produced under high temperature being stronger.

2. Fiber samples of the 1955 crop collected from various locations in the state showed: (a) Rank plants produced weaker and finer fiber. (b) A high negative correlation between fiber strength and free fatty acid content of the seed.

3. Approximately 1500 seed cotton samples from 17 gin locations throughout the state have been collected from the 1956 crop. These samples are being processed in the fiber laboratory.

17. THE IMPROVEMENT AND CULTURE OF CORN.

Project Number: 394. Funds: State Research. Personnel: A. D. Day, D. C. Aepli, F. Pritchard, L. C. Chapman, R. K. Thompson, and G. D. Massey.

Hybrid corn yield tests were grown at Yuma, Mesa, and Safford in an effort to select corn hybrids adapted to these three areas for both silage and grain production.

At the Yuma Experiment Station the following corn hybrids were the five highest yielding silage and grain varieties: silage - 1. Texas 26, 2. Mexican June, 3. Texas 28, 4. De Kalb 1051, 5. Texas 15W; grain - 1. United 65A, 2. Pioneer 9178, 3. Pfister 347, 4. Pfister 3254, 5. De Kalb 1051.

The following corn hybrids were the five highest yielding silage and grain varieties at the Mesa Experiment Station: silage - 1. Funk G-788, 2. Texas 15W, 3. Mexican June, 4. De Kalb 1002, 5. Funk G-740; grain - 1. Northrup King K3A, 2. Pfister 381, 3. Pfister 403, 4. Wisconsin 642, 5. Pfister 383.

At the Safford Experiment Station the following corn hybrids were the five highest yielding silage and grain varieties: silage - 1. Mexican June, 2. Funk G-740, 3. Funk G-787W, 4. Texas 32, 5. Funk G-792W; grain - 1. De Kalb 1002, 2. Pioneer 9178, 3. Texas 17W, 4. Texas 26, 5. Texas 28.

A corn date-of-planting test was conducted on the Yuma Experiment Station. The four planting dates were: 1. February 10, 2. March 5, 3. March 23, 4. April 20. Results: 1. In general, the early planting dates gave the highest silage and grain yields.

18. PRODUCTION AND IMPROVEMENT OF NEW CROPS FOR ARIZONA.

Project Number: 401. Funds: Hatch. Personnel: D. D. Rubis, K. C. Hamilton, D. F. McAlister, D. C. Aepli, R. K. Thompson, L. L. Patterson, L. C. Chapman, F. Pritchard, H. J. Czajkowski. E. H. Hartwig, W. L. Isom, M. L. Kinman, L. H. Zimmerman, P. R. Henson, N. W. Gilbert, U.S.D.A. collaborators.

Soybean variety tests at Yuma and Mesa indicate that several new lines may be superior to the variety, Lee. Date of planting and double cropping tests showed that May is the best planting date, but that soybeans may be grown successfully following barley. The new commercial inoculum provided good nodulation; nitrogen fertilizer showed no increase in yields.

Castor bean variety tests at Yuma, Mesa, and Tucson showed four hybrid varieties, Pacific 6, 415, Pacific Improved 4, and Cimarron suitable for production.

Safflower date of planting and variety tests at Safford, Mesa, and Yuma, showed that November 1 was the best planting date at Safford and December at Yuma and Mesa. Varieties N6 and N10 froze out at Safford, while N8 was frost resistant. The breeding and testing program at Mesa showed several new lines superior to N6 and N10 in yield, oil per cent, and root rot resistance. A new method of breeding for root rot resistance was developed by inoculating the soil with Phytophthora cultured on oats.

Sesame tests at Yuma and Mesa showed no varieties suitable for production.

Winter green manure crop tests at Yuma, Mesa, and Safford included several varieties of peas, vetches, clovers, and alfalfas. Papago peas produced the most dry matter and nitrogen per acre at Yuma and Mesa; at Safford, where frost damaged peas, sweet clovers and small grain showed more promise.

19. ECOLOGICAL EFFECTS OF FERTILIZERS ON DRYLAND RANGES.

Project Number: 424. Funds: State Research. Personnel: R. R. Humphrey (project leader), Bruce Branscomb, Raymond Honnas.

A study was initiated on the Vaca Ranch in San Rafael Valley in Santa Cruz County. Study plots were laid out in a grassland area that had been fertilized by aerial application with 16-20-0 fertilizer in June, 1956, at rates of 100, 250, and 450 pounds per acre. Because of very deficient 1956 summer rainfall, the fertilizer was not leached into the ground until January, 1957. Forage production, plant composition, and phenologic studies including initiation and rate of growth, plant vigor, flower stalk emergence, flowering period, seed setting and seed shattering have been intiated. No results are yet available.

20. DRYLAND LEGUMES FOR SOUTHWESTERN RANGE LANDS.

Project Number: 425. Funds: State Research. Personnel: D. G. Wilson.

No new transplants were attempted because of the drought conditions. Slightly more than one inch of rain was measured on the legume plot during the year. High mortality occurred in the 1955 transplants with only 21 of 230 plants still alive. Most promising varieties at this time appear to be PI 201864 (Iran), PI's 211607, 211608, 212858, and 212860 (all Afghanistan introductions).

Department of
ANIMAL PATHOLOGY

1. RANGE LIVESTOCK LOSSES FROM POISONOUS PLANTS.

Project Number: 171. Funds: Hatch. Personnel: Wm. J. Pistor, R. E. Reed, Robert Trautman.

1. Continued field investigations and chemical analyses were made. Plants were analyzed for possible nitrates or cyanides. Known poisonous plants were identified (In cooperation with Dr. Mason, Botany).

2. Fifty-four feeding tests and analyses were made on suspected plants.

Early spring barley caused considerable losses in cattle. Analyses showed some of them to contain as high as 5.8% potassium nitrate. Amaranthus Palmeri was suspected and several samples showed this plant to contain as high as 8.5% potassium nitrate.

Continuing analysis.

2. INFECTIOUS KERATITIS IN CATTLE.

Project Number: 199. Funds: Hatch. Personnel: Wm. J. Pistor, Robert Trautman.

Attempts were made to determine lysozyme activity in the tears of normal cattle and animals having infectious keratitis activity was measured according to the method of LITWACK, using a Coleman Junior Spectrophotometer to measure reduction in turbidity of a standardized suspension of micrococcus lysodeikticus as a substrate. The cells were cultured and prepared for suspension according to the method of LITWACK and PRAMER. No significant differences in lysozyme activity were found in tear samples taken from cattle having normal eyes as compared to tears taken from cattle with typical "pinkeye" infection.

Work continued, with blood lysozyme studies.

3. DIAGNOSTIC LABORATORY SERVICE.

Project Number: 339. Funds: State. Personnel: Wm. J. Pistor, R. E. Reed, Robert Trautman.

DIAGNOSTIC LABORATORY

1. Laboratory Diagnosis (Serological tests, bacteriology, histology, toxicology).

Bovine	1585
Equine	20
Poultry	5484
Milk & Water	29
Plant analysis	54
Miscellaneous	160

Ambulatory calls to farm	
Brucellosis and Tuberculosis tests on herd	229
Pregnancy diagnosis	117
Obstetrics and sterility	59
Surgery and treatments	136
Total cases at farm	541

Services to industry - Arizona does not have another laboratory or State Department to conduct these services.

Work being continued.

4. RESPIRATORY DISEASE IN ARIZONA POULTRY.

Project Number: 396. Funds: State. Personnel: Wm. J. Pistor, Robert Trautman.

Three-hundred-forty birds representing seventy-five flocks were submitted to the laboratory for necropsy. One-hundred-thirty-five birds representing forty-four flocks were diagnosed as having respiratory disease. The diseases encountered in this group were: Newcastle's, Coryza or colds, Laryngotracheitis, Chronic Respiratory disease and Infectious Sinusitis in turkeys.

Twelve flocks were diagnosed as having Newcastle's on the basis of history and post-mortem findings, seven of these diagnoses were confirmed by positive hemagglutination-inhibition tests using the Lederle method.

Representative samples from seventeen flocks showed symptoms of chronic respiratory disease. Diagnoses were made on the basis of characteristic lesions. Cultures for pleuropneumonia-like organisms were done routinely on the excised tracheas, using thallium acetate at a concentration of 1/2000 and 100 units of penicillin per ml. of medium. Agglutination tests for PPLO agglutinins were done using Adler's antigen. Positive agglutinations were noted in the serum of two birds and PPLO were isolated from seven of the specimens submitted. PPLO were identified by aseptically removing agar blocks from the plates which showed typical colonies and the entire block was fixed face down on a slide in Bouin's fixative and stained by the HCL-Geimsa method.

One turkey breeder desired to have his breeding flock tested for PPLO agglutinins to rule out the transmission of the organism through eggs which were sold for hatching. The owner submitted 667 blood samples for pullorum testing and 329 of these were tested for PPLO agglutinins with negative results.

A diagnosis of coryza was made on 13 groups of birds on the basis of gross pathological lesions at necropsy. Laboratory work on these birds was sporadic and results were variable.

Infectious sinusitis was suspected in two flocks of turkeys but laboratory tests were negative.

Laryngotracheitis was diagnosed in seven flocks on the basis of post-mortem findings in the trachea. Animal inoculations were attempted in the case of one outbreak. The inoculated birds failed to show symptoms of laryngotracheitis after a period of two weeks.

Infectious bronchitis was suspected in two flocks of chickens but serum neutralization tests were not done.

Work being continued.

5. HEMOGLOBINURIA IN PASTURE-FED AND RANGE CATTLE.

Project Number: 397. Funds: Hatch. Personnel: Wm. J. Pistor, R. E. Reed, Robert Trautman.

This project has been relatively inactive this past year due to the drought condition. Cattle have not been pastured to the extent of other years and very little feed has been available on ranges where this disease condition was previously noted.

The feeding operation that had a history for several years of hemoglobinuria did not experience any this year.

Numerous capillary tube agglutination tests have been made for practicing veterinarians over the State but no serious outbreaks have occurred.

This spring and summer should again give us conditions that could cause outbreaks of hemoglobinuria. The work planned for this year will be a continued attempt to correlate leptospira infections with nutrition in causing this disease.

Work being continued.

6. INTERNAL PARASITES IN RANGE, PASTURE AND FEEDLOT CATTLE.

Project Number: 422. Funds: Hatch. Personnel: Wm. Pistor, Robert Trautman.

One thousand and one individual samples of bovine feces were examined for internal parasites using the sugar flotation method. Total counts of the number of ova or oocysts were done on all samples. Results were expressed as ova or oocysts per gram of feces.

A preliminary count was done on two groups of range cattle to establish the presence of parasites in both areas. Ninety-seven animals were sampled individually, fifty animals represented one group and forty-seven the other. They were all yearling heifers and bulls.

In the group of forty-seven cattle, 28 were found positive for roundworm ova, the average E.P.G. count was 930 and the counts varied from 0 to 13,800. Nineteen animals also were positive for coccidia.

The other fifty animals were on the range in a different area and thirty-three or 66 percent of the individual fecal samples contained roundworm ova. The average E. P. G. count was 1070 and the range was zero to 8700 E.P.G. Twelve of these animals were positive for coccidia.

The animals of both groups were native to their particular range, consequently it was concluded that both areas were heavily invested with roundworms.

Approximately two months later preliminary E.P.G. counts were done on two different groups of animals occupying the same land. This group consisted of 135 head of bull and heifer calves and 2-year old heifers. Group A totaled 71 head and thirty-two or 45% of the fecal samples contained roundworm ova. Counts varied from 0 to 4500 E.P.G. Six fecals were positive for coccidia.

Group B was comprised of 64 head and twenty-five or 39% of the samples were positive for roundworm ova. The total numbers ranged from 0 to 2700. The average was 320 E.P.G. Nine of the specimens contained coccidial oocysts.

Subsequent egg counts will be done on groups A and B at various times throughout the year in an attempt to check seasonal variations in numbers of ova found in the feces of cattle.

Third stage larvae were hatched out from the samples containing roundworm larvae and an attempt was made to identify the species of roundworms present by measuring total length, length of esophagus, length from anterior end to genital primordium, length of tail and extension of tail sheath according to the methods of Hansen and Shivnani. Thus far no clear-cut differentiations of species has been possible on the basis of the measurements obtained.

Work being continued.

7. "COCCIDIOIDOMYCOSIS IN ANIMALS."

Project Number: 439. Funds: State. Personnel: Raymond E. Reed, Robert Trautman, P. G. Hugenholtz, K. T. Maddy, J. D. Barger.

Observation of naturally infected dogs was continued as it has been since 1952. Records of 28 dogs were added, bringing the total studied clinically, culturally, serologically and histologically to 93. This is many times the total canine coccidioidal infections observed from all other enzootic areas except Phoenix.

Experimental infection of cattle, started in 1955, was terminated with the animals on hand. Lack of funds prevented further work with cattle during the year. Conclusions to date are that the bovine accepts coccidioidal infection as a benign, asymptomatic disease. This supports observations of other workers made under feedlot conditions.

Work of prime interest initiated in 1956 with the cooperators listed above consisted of an inoculation trial with young, susceptible mongrel dogs. Infection was easily established and yielded useful preliminary information on incubation period, physical and serological response, and mortality, in relation to age of the dog and the number of spores inoculated.

Natural and artificially infected dogs suffering progressive coccidioidomycosis respond almost identically as does man to the progressive disease. No other animal has demonstrated this marked similarity. This points to the usefulness of the dog as an experimental animal to use in screening in vivo efficacy of promising therapeutics. When established on a statistically sound basis, knowledge that cattle are not physically affected by the disease will eliminate it from consideration as a problem.

Inoculation trials with dogs will be continued with support from the U.S. Public Health Service. Similar trials will be continued with the bovine if suitable susceptible cattle become available. A drug evaluation trial with amphotericin (Squibb) and possibly eulicin (Merck), both anti-biotics with in vitro fungicidal activity, will be started.

Publications:

"Diagnosis of Disseminated Canine Coccidioidomycosis." (Published)
"Ecological and Epizootiological Studies on Canine Coccidioidomycosis" (Published)
"Preliminary Report on Experimental Canine Coccidioidomycosis." (Manuscript)

Department of
ANIMAL SCIENCE

1. NUTRITIONAL STUDIES ON ARIZONA RANGE PLANTS AND CATTLE.

Project Number: 183. Funds: Hatch and State. Personnel: E. S. Erwin, R. S. Stone, C. B. Roubicek.

Three-hundred-fifty forage samples varying in stage of maturity and collected from various locations in Arizona have been subjected to several macro-element analyses. Calcium content varies from 0.02 to 0.14 with an average of about 0.06. The phosphorus level for some samples is less than 0.01 and ranges to 0.63 for some grasses. The average phosphorus content of grasses analysed is about 0.12.

Samples of oak and mahogany branches show a protein content of over 8.00 percent.

2. INFLUENCE OF FORAGE HARVESTING AND FEEDING METHODS ON BEEF PRODUCTION.

Project Number: 248. Funds: Hatch and State. Personnel: E. S. Erwin, C. B. Roubicek, O. F. McAlister, L. Rosenblatt, and F. Pritchard.

This experiment was designed to compare and evaluate different methods of alfalfa harvesting in a livestock feeding program, and to determine the effect of different supplements to green chopped alfalfa for growing and fattening steers. This trial was conducted at the University of Arizona Experimental Farm, Yuma, Arizona.

(a) Steers fed green chopped alfalfa plus a supplement of barley or molasses at a level of one-third pound per 100 pounds live weight made satisfactory gains and carcass grades. (b) There was no advantage in feeding the barley or molasses supplement at a level of two-thirds pound per 100 pounds body weight compared to the supplementation at half this level. (c) The supplemented green chop groups showed gains and carcass grades equal to hay fed steers which served as the control group. (d) No marked differences in feed consumption were noted between steer groups on the various rations. Consumption was slightly higher when alfalfa was fed as hay than when fed green. (e) Alfalfa was more efficiently utilized when fed as supplemented or unsupplemented green chop than when pastured. Rotation grazing was somewhat less efficient in feed utilization than strip grazing. (f) Bloat was a major problem in feeding and pasturing green alfalfa. Feeding alfalfa straw with green alfalfa was, at best, only partially effective in controlling bloat.

3. PROGENY TESTING OF HEREFORD SIRES.

Project Number: 279. Funds: Hatch, Regional Research, State.
Personnel: O. F. Pahnish, C. B. Roubicek, E. B. Stanley, G. E. Nelms, and E. S. Erwin.

Production data on 660 calves and yearlings from 11 sire groups have been processed by IBM. Regression coefficients for adjusting weaning age to 270 days have been computed. The coefficients, with 95 percent confidence limits are: bull calves 1.442 ± 0.146; heifer calves 1.090 ± 0.120.

Six bulls obtained from the U. S. Range Livestock Experiment Station, Miles City, Montana and three bulls obtained by the Apache Indian Tribe from other sources were bred to the purebred cow herd at the San Carlos Apache Indian Reservation in 1956. Complete production data, including birth weight and periodic weights and grades for two full years will be obtained for all progeny. Since the Montana bulls have progeny at Miles City, it will be possible to compare relative performance of sire groups under two different environmental conditions. It will also be possible to compare the progeny of the Montana bulls, selected for performance, with progeny of bulls selected by usual standards.

4. INVESTIGATION OF AN ACHONDROPLASIA-LIKE CONDITION IN HEREFORD CATTLE.

Project Number: 282. Funds: Hatch and State. Personnel: O. F. Pahnish, C. B. Roubicek, and G. E. Nelms.

Tests to determine the relationship between the gene responsible for the short-headed dwarf and a lethal condition encountered by the New Mexico Station are in progress. The New Mexico abnormality is lethal at birth. One lethal appeared in 13 progeny of one New Mexico bull bred to cows that were proven dwarf-producers. A second New Mexico bull that had sired lethal calves at the New Mexico Station, has now produced a typical short-headed dwarf in the Arizona test herd.

Birth measurements of dwarf and normal calves from various herds show that the distance from accessary carpal bone to the dewclaw is the most useful diagnostic means for differentiating dwarf and normal phenotypes. The dwarf measurements to date are all less than 13 centimeters, while measurements on normal calves exceed this.

5. THE EVALUATION AND UTILIZATION OF LOW QUALITY ROUGHAGES AS FEEDS FOR LIVESTOCK IN ARIZONA.

Project Number: 388. Funds: Hatch and State. Personnel: E. S. Erwin, and C. B. Roubicek.

Twenty-eight yearling steers were individually fed three levels of dehydrated alfalfa with and without molasses during a growing and fattening period where cottonseed hulls constituted the roughage source. Cottonseed meal was fed to approximate an isonitrogenous ration. The following results were obtained for the growing and fattening phases:

1. No significant difference in gains among steers fed 0,2, and 4 pounds of dehydrated alfalfa daily.
2. Steers fed one pound of molasses daily gained significantly less than steers fed the same ration without molasses.
3. As the level of alfalfa was increased, a more depressing effect from molasses was observed.
4. The addition of molasses decreased feed efficiency for all supplements tested.

In view of these findings, 30 steers are now being individually fed cottonseed hulls as the roughage source with five supplements varying in amounts of dehydrated alfalfa and containing molasses. Also, an antibiotic-salt mixture is being fed free-choice to half the steers on each supplement.

In another trial, 30 steers were individually fed unprocessed cotton gin trash in combination with other feeds. The following information was obtained:

1. Unprocessed cotton gin trash was as palatable as silage.
2. The addition of molasses did not increase palatability or efficiency of feed utilization.
3. Steers fed a combination of gin trash and silage gained as well as steers consuming all silage.
4. There was no apparent difference in carcass grades between gin trash and silage fed steers.

Based on these results, six ratios of cotton gin trash and hegari silage are now being fed to 108 steers. In addition, the steers fed each roughage ratio were divided into three sub-groups and implanted with diethylstilbestrol at three levels.

6. THE EVALUATION AND UTILIZATION OF CONDENSED BEET SOLUBLES AS A FEED FOR BEEF CATTLE.

Project Number: A.S. 391. Funds: State and Grant.
Personnel: C. B. Roubicek, E. S. Erwin, and J. W. Blair.

Comparative cost figures have frequently favored the inclusion of condensed beet solubles product, MC-47, in Arizona beef cattle rations. This is true providing the actual nutritive value of MC-47 corresponds closely to the estimated value based on known chemical composition. The use of MC-47 for livestock in Arizona is restricted by lack of information as to its palatability and nutritive value, when fed at different levels and under different dietary regimes.

Twenty-four yearling steers were allotted to four dietary treatments. All animals received hegari silage and a supplement consisting of alfalfa meal, cottonseed meal, steamed bonemeal and sodium sulfate. Lot 1 received 1.5 pounds of molasses; lot 2, 1.5 pounds MC-47; Lot 3, four pounds of molasses; and Lot 4, four pounds of MC-47. The supplement was adjusted to keep the rations isonitrogenous. Individual feed consumption and gain data were taken. During the 127 day growing period, lots 1, 2, and 3 gained two pounds per day. Lot 4 showed a

gain of 1.70 pounds per day. There was no significant difference in average daily feed consumption. At the conclusion of the growing period, the animals were group fed a fattening ration for 68 days. The average daily gain for lots 1, 2, and 3 was 1.55 pounds, for lot 4, 1.85 pounds. There was no apparent difference in dressing percentage or carcass grade between treatments.

7. FARM FLOCK SHEEP PRODUCTION ON SOUTHWESTERN IRRIGATED PASTURES.

Project Number: 403. Funds: Hatch and State. Personnel: G. E. Nelms, C. B. Roubicek, and L. Rosenblatt.

A farm flock of sheep has been maintained at the Yuma-Mesa Station for the past two years. Detailed production records are kept, including lamb and wool production. There have been no serious difficulties due to high temperatures.

Three breeding practices are being compared: (a) grading-up Rambouillet range ewes, using purebred Rambouillet rams, (b) purchase older bred range ewes to be used for one lamb crop, replacing them with another set of similar ewes in the fall and spring of each year, and (c) a rotational cross-breeding program using Rambouillet, Suffolk, and Lincoln rams on foundation Rambouillet ewes.

Due to the difficulty in obtaining bred range ewes when needed, the buy-sell phase of the project has been incorporated in the grading-up and crossbreeding phases.

Since it appears advantageous to market the lambs as soon as possible, a creep feed for lambs is being investigated.

8. THE EFFECTS OF CLIMATIC AND NUTRITIONAL STRESSES ON GROWTH AND PRODUCTIVITY OF RANGE CATTLE.

Project Number: 411. Funds: Hatch, Regional Research, and State. Personnel: G. E. Nelms, C. B. Roubicek, and R. R. Stone.

Range cattle are especially important to the State economy since they utilize land that is suitable only for forage production. Because much of the land is located in low-rainfall, high-temperature areas of the State, these animals are subjected to periods of extreme environmental stress. In order to make sound recommendations to producers, it is necessary that we know the effects of these environmental conditions on growth and productivity of range animals.

Effects of stresses are being studied with identical twins. One twin of the pair is subjected to a specific stress while the mate serves as a control. The stresses being studied include low phosphorus, low protein, low energy, low vitamin A and high temperatures.

It appears that water consumption is affected by type of ration and shade, when maximum temperatures are above 90° F. Steers on dry rations consume about 2.5 liters more water than steers on rations containing silage. The steers consumed on the average, 5.48 liters per 100 lbs. live weight. The maximum temperatures averaged 98.5° F.

When the shade is located such that little or no benefit is received by the steers during the hot part of the day, water consumption is affected. The steers receiving adequate shade drank on the average of 1.5 liters less water than steers receiving inadequate shade.

An attempt is being made to determine the effect of increasing temperatures on water consumption. The problems of the animals increasing in body weight as the temperatures increase, and increasing body weights with decreasing temperatures are being studied.

9. THE INFLUENCE OF LOW-LEVEL STILBESTROL IMPLANTATION ON FEEDER LAMBS TREATED WITH DIETARY ANTIBIOTICS AND TAPAZOLE IN "LOW QUALITY" ROUGHAGE FATTENING RATION.

Project Number: A.S. 428. Funds: State. Personnel: Joe Blair, E. S. Erwin, and C. B. Roubicek.

Tapazole, the most potent goitergenic material known, and antibiotics are being fed in all possible combinations to 120 lambs implanted with 0, 3, and 6 mg. of stilbestrol. Forty-eight lambs were subjected to digestion trials to determine the influence of the "drugs" on nutrient utilization. Blood and liver samples will be obtained from 80 lambs for vitamin A, carotene, and cholesterol determinations. Average daily gain, feed consumption as influenced by treatment will be determined. Thyroid and adrenal glands will be extracted from all lambs at slaughter to determine treatment effects on their respective weights. Slaughter data will include dressing percentage, cooler shrink, and carcass grade.

10. THE INFLUENCE OF DIETARY FAT ON THE UTILIZATION OF CAROTENE AND THE DIGESTIBILITY OF RATION CONSTITUENTS BY VITAMIN A DEFICIENT AND NORMAL STEERS.

Project Number: A.S. 430. Funds: State. Personnel: E. S. Erwin, C. B. Roubicek, H. Page.

Normal and deficient steers will be fed diets with and without fat that contains equal amounts of carotene. Liver and blood samples will be taken before and after 18 days of feeding to determine relative vitamin A and carotene changes as influenced by treatments. In addition, carotene, crude protein, fat, and crude fiber digestion, as influenced by treatments, will be determined in a digestion trial with 20 steers.

11. SALT REGULATION OF TERRAMYCIN AND DIETHYLSTILBESTROL FOR DRY LOT LAMBS.

Project Number: A.S. 432. Funds: State. Personnel: E. S. Erwin, L. Rosenblatt, C. B. Roubicek, F. Pritchard.

Sixty-four lambs were fed a 70 percent alfalfa ration free-choice for 64 days. Diethylstilbestrol (DES) and terramycin (T), were mixed singly and together with salt and fed free-choice to lambs. In addition, 6 mg. of (DES) was implanted in half the number of lambs not receiving (DES) in salt. No "side effects" from stilbestrol feeding or implantation was observed in the live animals, or in their respective carcasses. Average daily gain by treatment was as follows: Control, .378; 6 mg. 1,463; T, .344; T + 6 mg., .574; DES-salt, .473; T + DES-salt,..544.

12. ANTIBIOTICS, STILBESTROL, AND INEDIBLE ANIMAL FAT AS SUPPLEMENTS FOR FEEDER LAMBS PASTURED ON ALFALFA.

Project Number: A.S. 433. Funds: State. Personnel: E. S. Erwin, L. Rosenblatt, C. B. Roubicek, F. Pritchard.

Feeder lambs pastured on alfalfa were subjected to a 2 x 2 x 2 factorial designed study involving antibiotics in salt (free-choice); 6 mg. diethylstilbestrol implant, and.5 lb. of a fat supplement (20% tallow and 80% cotton gin waste). The lambs receiving no fat supplement were fed equal amounts of straw. Insufficient data are available to present results at this time.

13. THE EFFECT OF VARIOUS LEVELS OF TAPAZOLE ON FEEDER LAMBS TREATED WITH LOW-LEVEL STILBESTROL IMPLANTATION.

Project Number: A.S. 434. Funds: State. Personnel: J. W. Blair, E. S. Erwin, and C. B. Roubicek.

Because of the indication of increased rates of gain due to Tapazole (goitergen) and stilbestrol in a previous study, this investigation was undertaken. Four groups of lambs were implanted with stilbestrol while one group remained untreated. A similar basal ration containing four levels of Tapazole was fed to the implanted animals.

14. THE EFFECT OF TYPE OF DIETARY PHOSPHROUS ON THE GROWTH, NUTRIENT DIGESTION, AND VITAMIN A UTILIZATION IN SHEEP.

Project Number: A.S. 435. Funds: State. Personnel: E. S. Erwin, T. Varnell, and C. B. Roubicek.

The influence of bone meal, poly phos, and soft phosphate on vitamin A utilization, nutrient digestion, and growth in individually fed lambs will be elucidated.

15. GIN TRASH - ALFALFA RATIOS AND CONCENTRATE - ROUGHAGE RATIOS FOR FATTENING LAMBS WITH AND WITHOUT STILBESTROL IMPLANTS.

Project Number: A.S. 437. Funds: State. Personnel: E. S. Erwin, C. B. Roubicek, J. W. Blair.

A 3 x 3 factorial design involving three ratios of alfalfa: cotton gin waste in all possible combinations with three concentrates:roughage ratios are being studied with replicated pen-fed ewe and wether lambs. In addition, all lambs were implanted with stilbestrol to determine the influence of sex and diet on stilbestrol response. This study should provide information on economical feeding practices involving low-quality roughages.

16. THE EFFECT OF VITAMIN A DEFICIENCY ON THE UTILIZATION OF METABOLIC AND DIETARY CAROTENE IN WETHERS.

Project Number: A.S. 438. Funds: State. Personnel: E. S. Erwin.

The influence of vitamin A deficiency on the utilization of intravenous and dietary carotene in sheep will be undertaken to further elucidate factors that influence the biological value of carotene.

Department of
BOTANY

1. THE NUTRITIONAL REQUIREMENTS FOR INCREASED FAT PRODUCTION BY SELECTED CROP PLANTS.

Project Number: 250. Funds: Hatch. Personnel: E. B. Kurtz, Jr.

Earlier in this study it was shown that, by drastically reducing the nitrogen supply of young flax plants, the fat content of the leaves and stems could be increased from 3 to 7 and 15 percent. Apparently certain environmental conditions must be concomitant with the low nitrogen supply, since the increased fat production could not be repeated under greenhouse conditions of low light intensity and low temperature. Therefore the experiments have been repeated under high day temperatures (80-95°F.) and high light intensities (up to 12000 f.c.), but the analyses are not completed. Study of the factor in flax fruit extracts which stimulates fat production has been suspended until the environment-nitrogen problem is resolved.

If successful, this project would provide a means for greatly increasing the yield of vegetable fats.

The interrelationships of light, temperature, nitrogen supply, and fat content of the vegetative shoot must be resolved by experiments under controlled conditions, within the limits of our facilities.

2. THE SYNTHESIS OF FATTY ACIDS IN A HIGHER PLANT.

Project Number: USAEC Contract AT-(11-1)-262, Supplements 2 and 3.
Funds: Non-Federal. Personnel: E. B. Kurtz, Jr. and Arturo Miramon.

The effect of certain factors on fat metabolism has been studied by means of the in vitro culture of developing flax embryos, with acetate-1-C^{14} as a substrate. The optimum temperature for the system is 16-17°C. Light (as low as 40 f.c.) is essential for maximum incorporation of the substrate, although some incorporation always occurs in the dark. The possibility of there being a specific photochemical reaction in the sequence of reactions involved in fatty acid synthesis is being investigated. The quality of light required by the system is also being studied. Biotin has been shown to be required for fatty acid synthesis. The amount of biotin required increases from 1 microgram for 10-day-old embryos to about 1000 micrograms for 18 or 20-day-old embryos. The possibility of biotin being required for the conversion of one acid into another is being investigated. Chromatographic and autoradiographic methods have been developed for use in elucidating the specific roles of light and biotin in fatty acid synthesis.

This study is providing basic knowledge about the mechanism of biosynthesis of fats in plants. Such information may apply to agriculture and medicine.

3. UNIVERSITY OF ARIZONA HERBARIUM.

Project Number: 327. Funds: State. Personnel: Charles T. Mason, Jr.

The herbarium of the University of Arizona acts as the center for plant determination. In addition to identifying specimens for the departments of Bacteriology, Animal Pathology, Plant Pathology, Horticulture, Animal Science, Entomology and Zoology and the College of Pharmacy, identification and information for 642 specimens were furnished to Arizona citizens, either directly or through County Agricultural Agents, and to tourists.

In addition, the herbarium serves as a repository for vouchers of research work; it represents an inventory of the state flora and shows the distribution of the plants in the state. It aids in the study of intraspecific and interspecific variation; it serves as a reference library to facilitate the identification of new plants.

To the herbarium were added 6,782 new specimens. Exchange with other institutions continued but because most institutions owed us material, disbursements were low. 184 specimens were sent out, and 1,599 were received.

Loans continued throughout the year with 331 specimens being sent out, and 1,141 specimens still outstanding.

The projected plan is to continue our service to other departments and to the citizens of Arizona, and to increase our knowledge of the native plants through a more active study of little known areas.

4. WEEDS OF ARIZONA - COMMON NOXIOUS AND POISONOUS WEEDS OF ARIZONA.

Project Number: 331. Funds: State. Personnel: K. F. Parker (Resigned)

The weed bulletin is planned as an aid to the citizens of Arizona in the identification of the common troublesome and harmful plants in the state. All types of weeds occurring in Arizona will be treated -- those found in cultivated crops, gardens, overgrazed cattle ranges, roadsides, wastelands and disturbed soils. A description of the plant, and a discussion of its habitat and distribution within the state is prepared for each weed. A line drawing will accompany the more important ones. A chapter will be included on the methods of control and eradication.

Dr. Parker was able to spend part of the summer of 1956 on the project and plans to return to Tucson during the summer of 1957 to continue the work.

5. INVESTIGATIONS ON THE STOMATAL MECHANISM.

Project Number: 385. Funds: Hatch. Personnel: Robert M. Harris.

Utilizing techniques employing potometers, porometers and Dewcels, to measure changes in vapor pressure, it has been definitely established that the stomates of normal, green corn seedlings respond to light while the stomates of albino seedlings do not. The same techniques have been used to study the effects of light on the stomates of mutant carotinoid corn seedlings. The stomates of carotinoid seedlings like those of the albino do not respond to light. Field studies on the stomatal behavior of native plants have shown that the usual injection techniques are not satisfactory for investigations on the leaves of many desert plants. New methods utilizing Dewcels may prove most valuable in these field studies.

The findings of the past year indicate that chlorophyll and photosynthesis are necessary for the opening of stomates in light.

Present studies to demonstrate the effect of different wave lengths of light, carbon dioxide concentrations and temperature on stomatal behavior will be continued both in the laboratory and the field.

6. ROOT DEVELOPMENT OF FORAGE CROP SPECIES AS INFLUENCED BY PHYSICAL AND CHEMICAL FACTORS.

Project Number: 427 (Reg. No. W-47). Funds: Regional Research.
Personnel: Walter S. Phillips.

The University of Arizona's project in connection with W-47 was one of two projects activated during the year; the money was received on December 3, 1956, and work commenced immediately. Anticipating the activation of this project, I worked on methods of growing and measuring seedling growth. Glass cells were made and used to grow young seedlings under uniform growth. These cells can be periodically photographed and measurements made a permanent record. Various types of growth cells were tried, all with some defects.

7. METHODS AND APPLICATION OF POLLEN ANALYSIS IN THE SOUTHWEST.

Funds: Non-Federal. Personnel: E. B. Kurtz, Jr.

One of the major problems confronted in the application of pollen analysis to the Southwest is the low frequency of pollen in the soil. As a result large soil samples must be used for analysis and the accepted methods of pollen extraction are not applicable or are too costly. In order to resolve this problem a new method of analysis was developed which is inexpensive, simple, and may be used with any size of sample. Further, the method more highly concentrates the pollen as compared with other procedures. The new method is being used by several graduate students at the University of Arizona for the study of past vegetation and climate in the Southwest.

This work has provided a new and improved method for the extraction of pollen from soils and should greatly facilitate the application of pollen analysis to non-peat bog areas.

8. NUTRITIONAL RESPONSES OF CANTALOUPES, PARTICULARLY WITH REFERENCE TO THE DISEASE, CROWN BLIGHT.

Funds: Non-Federal. Personnel: E. B. Kurtz, Jr.

Crown blight has become a serious disease of cantaloupes in the Southwest. As yet the causal agent is not known.

Typical crown blight symptoms were produced on two varieties of cantaloupes, Arizona Sunrise and PMR-6, by growing plants without magnesium or calcium, or potassium. The disease may not be attributed to either salinity or pH since plants grown in nutrient solutions containing up to 4500 ppm NaCl or with a pH of 5.0 to 9.5 failed to exhibit any disease symptoms.

9. A STUDY OF THE RELATIONSHIP BETWEEN THE ARIZONA REPRESENTATIVES OF GENTIANA PARRYI AND GENTIANA AFFINIS.

Funds: State. Personnel: Charles T. Mason, Jr.

Gentiana Parryi and Gentiana affinis represent two of several species in the section Pneumonanthe of the genus Gentiana. They are found from Arizona to British Columbia and from Minnesota to the Pacific Coast. In the Arizona portion of their range they are sympatric. A cytological, morphological, genetical and distributional study of these two species is being made in an attempt to determine the relationship between them and to increase our knowledge regarding the cause and nature of speciation. This investigation represents a portion of a larger study supported by the National Science Foundation.

Collections of the two species were made during the last week of August in the Flagstaff, Kaibab and White Mountain Areas. Many herbarium specimens were taken and several plants were brought into the greenhouse for further study.

Collections of more specimens from several of the western states are planned, and arrangements have been made to transfer most of the greenhouse work to the Museum of Northern Arizona at Flagstaff.

10. A SYSTEMATIC STUDY OF THE GENUS FLOERKEA.

Funds: State. Personnel: Charles T. Mason, Jr.

The plant family Limnanthaceae contains two genera, Limnanthes and Floerkea. A taxonomic study of Limnanthes has been completed and a study of Floerkea is underway with an investigation of the morphological variation, cytology, distribution, and megagametophyte development within the genus. This is strictly a scientific investigation to determine, if possible, the evolutionary history and relationship of the two genera in the family.

Plans call for a continuation of the cytological, morphological, and distributional study of Floerkea.

11. GENETICS OF BACILLUS MAGATHERIUM.

Personnel: Murray W. Coulter and Robert M. Harris.

Biochemical and antibiotic mutants of Bacillus megatherium were isolated using Lederberg's indirect selection method. Mutants unable to synthesize such compounds as methionine, arginine, leucine and valine were identified.

The antibiotic mutants isolated included some resistant to either penicillin or streptomycin as well as several strains which were streptomycin dependent. One streptomycin dependent strain was able to utilize the vitamin inositol as a substitute for streptomycin. Another strain dependent on streptomycin could have this requirement replaced by ascorbic acid.

These findings indicate that streptomycin dependence in bacteria is related to the utilization of inositol and ascorbic acid in the metabolism of the organism.

Department of
DAIRY SCIENCE

1. FACTORS RELATED TO OXIDATION REACTIONS IN MILK, MILK PRODUCTS, AND MILK CONSTITUENTS.

Project Number: 320. Funds: Hatch. Personnel: J. W. Stull.

Various procedures were investigated for measuring oxygen absorption rates in 50 ml. samples of whole milk in 125 ml. B.O.D. flasks at 34°C. using a Barcroft-Warburg respirometer.

It was found that a combination of 0.3 gamma aureomycin, 0.3 units penicillin, 1.0 gamma terramycin, and 4.2 gamma streptomycin per ml. would effectively retard microbiological changes under these conditions for at least 8-10 hours. Preliminary results indicate that both autocatalytic and catalytic oxidation rates in whole milk can be measured under these conditions.

2. PELLETS MADE FROM DEHYDRATED IMMATURE ALFALFA AS A SUPPLEMENT FOOD FOR MILK PRODUCTION.

Project Number: 377. Funds: Hatch. Personnel: 1956 trial, R. N. Davis, F. G. Harland, J. W. Stull; 1957 trial, R. G. Fossland, J. B. Fitch.

Two groups of seven cows each consisting of Holsteins, Guernseys, and Jerseys were fed through three 28 day periods from November 29, 1955, to March 13, 1956.

Group I was fed alfalfa hay and hegari silage through a three day preliminary period and a 25 day experimental period then changed to hay, silage, and pellets and back to hay and silage in the third period.

Group II was fed dehydrated immature alfalfa pellets and silage ad libitum during periods I and III and alfalfa hay, silage, and pellets during period II. This plan was later changed to include some alfalfa hay to give bulk to the pellet ration.

The cows were fed 1½ pounds alfalfa hay and 3 pounds hegari silage per 100 pounds live weight.

The pellet group was fed on the basis of 100 pounds of alfalfa pellets per 100 pounds live weight plus all the silage, hegari, that the cows would eat.

Unfortunately the leader on this project left to accept another position before the results were summarized. The data recorded is incomplete and has no meaning to others who try to summarize the results.

3. THE EFFECT OF COOLED DRINKING WATER ON MILK PRODUCTION BY DAIRY CATTLE DURING PERIODS OF PROLONGED HIGH ENVIRONMENTAL TEMPERATURES.

Project Number: 386. Funds: Hatch. Personnel: J. W. Stull, F. G. Harland.

A double reversal trial with twenty-one-day periods was run between July 1st and September 14, 1956. The control lot of 9 animals received drinking water maintained at 95±3°F. The experimental group was provided drinking water at 60±4°F.

There were no significant differences in the two groups in milk production, body weight, body temperature, or respiration rate. Hay consumption appeared to be lower in the experimental group. Water consumption was definitely less in the group receiving the cooled drinking water.

4. THE EFFECT ON MILK PRODUCTION OF FEEDING A COMPLETE PELLETED RATION TO DAIRY COWS.

Project Number: 423. Funds: Hatch. Personnel: R. G. Fossland, J. B. Fitch, L. Strang.

Eighteen cows were divided into three groups and fed on a reversal plan. The rations compared were:

1. A complete pellet consisting of 75% alfalfa and 25% of a 10% protein grain mixture. The cows were fed individually calculated amounts adjusted monthly.
2. Fed complete pellets free choice as a group.
3. Fed alfalfa hay in proportion to body weight and grain in proportion to milk production.

Group	1st Period	2nd Period	3rd Period
I	1	3	1
II	2	1	2
III	3	1	3

Observations to date:

The cows lost approximately 4% in body weight on hay and grain and 7% when fed pellets. The cows declined approximately 26% in milk production on hay and grain and 40% on pellets. Some of the cows bloated when fed pellets, had no cud, and also chewed on the wooden fences. There is also some reason to believe that the cows in the pelleted group are more difficult to breed. The fat percentage and total solids were lowered on the pelleted ration. The fat percentage was down as low as 1.8% for the Holsteins. The animals recovered the fat percentage after two weeks on the hay feeding. Changes were less violent on the low producing animals. Two of the cows have gained body weight on the pellet feeding.

Department of
ENTOMOLOGY

1. INSECTS AND MITES AFFECTING ALFALFA IN ARIZONA.

Project Number: 322. Funds: Hatch, State and U.S.D.A.
Personnel: Donald M. Tuttle, Vincent D. Roth and Frank E. Todd (U.S.D.A.)

Seed Treatments for Spotted Alfalfa Aphid Control.

Between December, 1955, and May, 1956, twelve seed treatment tests were conducted. Twenty-four insecticides were used one or more times during these tests. Seeds were treated by soaking in solutions prepared from insecticide emulsions, or by treating dampened seeds with insecticide dust formulations (with and without activated charcoal). In later tests 5 percent methyl cellulose solution was used to more firmly attach the insecticide to the seed. The data from these tests indicate that both Thimet and lindane dust formulations, at the rate of 4 ounces of actual toxicant per 100 pounds of seed, appear suitable for effective use as seed treatment by growers for the protection of seedling alfalfa from attacks of the spotted alfalfa aphid. Other insecticides of possible promise in 1956 seed treatment experiments require further testing, preferably at higher dosage rates on methyl cellulose-coated seed, before their usefulness and practicality can be established. Three series of tests were conducted to measure possible effects on germination resulting from insecticidal treatments of alfalfa seed for the protection of seedlings from attack by the spotted alfalfa aphid. Although a tendency may be noted toward lower germination rates of treated seed, the reductions in most cases appear too slight to be important. It therefore seems desirable to consider the use of higher dosages of insecticides in future seed treatment tests, particularly in conjunction with methyl cellulose coatings, with a view toward increasing the degree of protection of alfalfa seedlings from aphid attacks.

Soil Treatments for Spotted Alfalfa Aphid Control

Four tests were made in the Yuma area to measure possible effects of insecticides, applied to the soil at the time of planting, upon subsequent growth of alfalfa plants, and on infestations of the spotted alfalfa aphid. It is concluded that soil applications of certain insecticides, including benzene hexachloride, Diazinon, lindane, and Thimet offer a promising means of controlling the spotted alfalfa aphid on young alfalfa plants. In most cases, however, the cost of a sufficient amount of insecticide for adequate control appears to be prohibitive. Some control was obtained by applying granular formulations of insecticides to young alfalfa seedlings with a fertilizer spreader although equal results were obtainable at lower cost by applications of certain insecticidal dust formulations.

Foliage Treatments for Spotted Alfalfa Aphid Control

In tests at Yuma good to excellent control of the spotted alfalfa aphid resulted from applications of dusts containing parathion, malathion, benzene hexachloride, lindane, and Diazinon. Good, but slightly less effective aphid control has resulted from dust applications containing Chlorthion, endrin, compound AC 528, and a mixture of 15% toxaphene, 5% DDT, and 40% sulfur. Dust

applications of sulfur, without other toxicants, have given 80 to 85% aphid control. The addition of sulfur has usually increased the effectiveness of dust formulations of other insecticides against the aphid.

Spray formulations of Systox, parathion, malathion, Chlorthion, Diazinon, and benzene hexachloride have given outstanding control of the spotted alfalfa aphid. Slightly less effective results have been obtained with sprays containing toxaphene, endrin, Guthion, DDT, and TEPP. Except for the latter, the performance of these insecticides as sprays has not been uniformly consistent. Compound AC 528, aldrin, dieldrin, and chlordane have occasionally given good aphid control when used as sprays. Spray formulations of experimental compounds OS 2046 (Phosdrin) (Shell), 2032 (Hercules), and 8305 (Carbide and Carbon Chemicals Company) have recently shown promising results. Spray applications of most insecticides were effective against aphids for about 14 days, although applications of Systox have been effective for as long as 21 days. Spray applications have been most effective when applied with ground equipment, at pressures of 80 to 100 pounds per square inch, at rates of 10 to 12 gallons of spray per acre.

Insects Affecting Alfalfa Seed Crops.

Further investigations were continued at Yuma on insects affecting alfalfa seed crops. The area involved in 1956 included 2200 acres representing approximately 2.5 square miles on the Yuma Mesa. The acreage was provided with sufficient pollination by introducing honey bees at the rate of two colonies per acre. Weekly surveys demonstrated that parathion dust was not as efficient in controlling lygus bugs and worms as toxaphene and DDT combinations. Parathion was particularly detrimental to predators and parasites. Yields of field run seed ran from 400 to 750 pounds per acre. Fields with thick stands started in April produced excessive vegetative growth, and averaged 400 pounds of seed per acre. Thin stands produced 500 to 750 pounds per acre when started in late April or the first of May. Seed crops started later usually set more seed and produced higher yields. Lygus bugs were especially abundant in 1956 and proved difficult to control even with repeated treatments. Flower drop was excessive at times in some fields with high lygus counts. One field in which no insect control was applied produced less than 100 pounds of seed of poor quality. Most of the fields averaged about 20% clean out. A high percent of the brown seed was attributed to damage by lygus bugs.

2. THE BIOLOGY AND CONTROL OF INSECTS AFFECTING COTTON IN ARIZONA.

Project Number: 383. Funds: Hatch and State. Personnel: A. D. Telford, Jr. (Resigned), D. M. Tuttle and P. D. Gerhardt.

Triplicate experiments, under varying conditions of climate, were conducted at Yuma, Tempe and Bowie to observe the effects of Thimet on the control of early season cotton pests. Thimet, a systemic phosphate compound, was used in a 44% formulation with carbon powder and 2% methly cellulose, applied at the rate of one pound of actual toxicant per acre. Effects were measured in terms of stands, infestations, bolls and yields. Thimet was mildly phytotoxic to treated seed as evidenced by slightly delayed emergence and burned areas on the cotyledons. Thrips were the only early season pests of importance in the test fields. Infestations appeared later than usual and after the systemic effects of the Thimet had become largely attenuated. Consequently, there were no significant differences between treated and untreated plots in any area. The major portion of the manuscript of Experiment Station Bulletin 286, "Arizona Cotton Insects" was prepared during 1956.

The cotton leaf perforator was the most serious pest of cotton encountered for 1956 in Yuma County. Satisfactory control was obtained only with two spray applications spaced at intervals of 10 days using parathion, Toxaphene plus DDT or endrin. This insect has become increasingly important since 1952. Since this insect continues to reproduce the year around and builds up in stub cotton, it seems desirable that fields be plowed or disced thoroughly in the winter, and that the practice of stubbing cotton be abandoned.

During August 1956 a cotton field near Gilbert, Arizona, was seriously infected with the mite Tetranychus cinnabarinus. Excellent control of this mite was obtained following air applications of emulsion concentrates of Kelthane, Compound AC-528, Trithion and Systox at rates of 1, $\frac{1}{2}$, $\frac{1}{2}$ and $\frac{1}{4}$ pounds of actual toxicant per acre, respectively.

3. THE BIOLOGY AND FOOD PREFERENCES OF THE KHAPRA BEETLE AS THEY RELATE TO GRAIN MARKETABILITY.

Project Number: 389. Funds: Regional Research (9b3), State and U.S.D.A. (Contract). Personnel: W. L. Nutting, P. D. Gerhardt, L. A. Carruth.

1956 studies of the khapra beetle in Arizona emphasized observations of natural infestations in advance of an eradication campaign which may make similar observations difficult or impossible in the near future. For this reason laboratory studies, of the type mentioned in the project outline, were temporarily postponed.

In studies of khapra beetle food preferences in large commercial bulk storage infestations it was found that populations developed more rapidly and intensely in barley than in milo stored under similar conditions. In barley, high intensity infestations developed within six weeks although infestations in milo remained low after a similar period.

The following natural enemies of the khapra beetle were collected during the sampling of bulk storages in Arizona: Xylocoris flavipes (Reuter), an anthocorid determined by R. I. Sailer; also found were two hymenopterous parasites, Cephalonomia watersoni Gahan (Bethylidae) and Anisopteromalus calandrae (How.) (Pteromalidae), determined by B. D. Burks and K. V. Krombein.

Khapra beetle larvae were found feeding on dead birds, dead insects, and other natural food sources. The possibility of such media serving as natural reservoirs for maintaining khapra beetle infestations is being further investigated.

Other grain insects found during khapra beetle surveys in commercial barley and milo storages in Arizona included the confused flour beetle, flat grain beetle, lesser grain borer, saw-toothed grain beetle and rice weevil.

This work was done in coordination with other work supported by a research contract between the U.S. Department of Agriculture, Agricultural Marketing Service, and the University of Arizona.

4. INSECT PARASITES AND PREDATORS OF INSECT PESTS OF ARIZONA CROPS.

Project Number: 404. Funds: Hatch and State. Personnel: G. D. Butler, F. G. Werner.

This project was begun in the summer of 1956. Progress centered about the first stage of this project, designed to obtain information on the identity, distribution and relative abundance of parasitic and predaceous insects in and near the principal agricultural areas of Arizona. During the season 40,000 specimens were collected for further study. Particular emphasis in 1956 was given to the study of the Syrphidae, Tachinidae, Reduviidae, Nabidae and Coccinellidae. Manuscripts were prepared dealing with the Arizona species of the first two families named above.

5. INSECTICIDE RESIDUES: THEIR NATURE AND PERSISTENCE ON ARIZONA CROPS.

Project Number: 416. Funds: Regional Research (9b3) and State. Personnel: J. M. Witt.

This new project was activated July 1, 1956. Attention was given to the first objective of establishing adequate facilities and standard procedures for the detection and measurement of insecticide residues on crops of agricultural importance in Arizona. A well-equipped laboratory has been completed and standard procedures for cholinesterase inhibition analysis and bioassay have been established in preparation for active work on the main objectives of this project in 1957.

6. INSECT PESTS OF ARIZONA VEGETABLE CROPS.

Project Number: 418. Funds: State. Personnel: P. D. Gerhardt, D. M. Tuttle, O. A. Hills (U.S.D.A.)

Lettuce Insects

For the control of cabbage loopers and armyworms on fall lettuce, four insecticidal sprays and two dusts were tested, in comparison with untreated plots, at the Bodine Ranch, Glendale, Arizona. Each formulation was applied four times, at approximately weekly intervals, during late September and October. Best results were obtained in plots treated with 15% Toxaphene-10% DDT dust, applied at the rate of 40 lbs. per acre, or with Phosdrin spray, applied at the rate of 1.7 pounds of actual toxicant per acre. A toxaphene-DDT emulsion spray, containing these toxicants at the rate of 3.2 lbs. and 1.6 lbs., respectively, per acre was also effective. Spray applications of Guthion and spray and dust applications of Dipterex (Dylox) were less effective. The principal objection to Toxaphene-DDT applications is the persistence of toxic residues, which preclude treatments near harvest. Phosdrin, with its short residual life, appears, therefore, to be particularly suited for applications required for looper control near the harvest period.

Sweet Corn Insects

In sweet corn at the Mesa Farm, infestations of the lesser cornstalk borer were reduced, although not to a commercially acceptable extent, by insecticide applications to the soil surface. Among the materials tested were granular formulations of Aldrin, dieldrin, heptachlor, Thimet and Nemagon. Materials were applied in bands before planting, after planting and at the time of emergence. Aldrin, dieldrin and heptachlor were the most promising, although results were not sufficiently outstanding to be recommended for general use.

Dust formulations of endrin, heptachlor, parathion and AC 528, applied to sweet corn plants 18 to 20 inches high at the Mesa Farm, had little if any effect in reducing infestations and injury of the southwestern corn borer.

Cantaloupe Insects

Tests against dipterous leaf miners were conducted in experimental plots of cantaloupes planted on April 4, 1956, on the University Experiment Farm at Yuma, Arizona. Thimet, Demeton, and Parathion sprays were applied by means of a CO_2 wheelbarrow sprayer using cone-type 3X T-jet nozzles at 50 pounds pressure. Four applications were made to each plot at various stages of development. Parathion was the most effective. Significant increases in yield were obtained for the parathion treated plots over the untreated check plots.

As a result of a low percentage of virus carriers and comparatively low leafhopper populations, practically no curly top occurred in cantaloupe fields in the Yuma area in 1956. The average of 0.42 beet leafhoppers per square foot in cantaloupe fields was not high although, if a high percentage of the insects had been virus carriers, curly top disease could have caused serious reductions in yield of cantaloupes in some fields in the Yuma area.

7. ARIZONA INSECTS OF ECONOMIC IMPORTANCE.

Project Number: 419. Funds: State. Personnel: L. A. Carruth, G. D. Butler, P. D. Gerhardt, D. M. Tuttle, F. G. Werner.

(This project includes exploratory work leading to new projects and other essential miscellaneous Experiment Station activities in Entomology).

Investigations of Citrus Insects

Cottony cushion scale infestations increased on grapefruit and lemon trees in Maricopa County in 1956, possibly because of adverse effects of phosphorus insecticides on the Vedalia lady beetles which normally keep scales in check. In certain instances Vedalia beetles were unable to establish themselves until late in the season, with the result that scale infestations increased and fruit quality was lowered. 1956 tests of insecticides for scale control indicated that, over a 5-month period, Diazinon was more effective than Chlorobenzilate when used in standard spray formulations.

The flat mite, Brevipalpus lewisi, was a pest of tangerines in Maricopa County in 1956. A spray containing 4 oz. of Kelthane per 100 gals. of water was more effective against this mite than sprays of Guthion and Chlorobenzilate, in tests at the Citrus Experiment Station. The importance of proper timing and thorough spray applications was indicated.

Pests of Castor Beans and Safflower

Because of the potential importance of castor beans as a field crop in Arizona, preliminary observations were made of insects of possible importance. In regular surveys in the Mesa-Scottsdale area in 1956, the more important castor bean pests were leaf miners, lygus bugs, leafhoppers, leaffrollers and armyworms. The most common insect predators were green lacewings, Collops beetles, ladybird beetles, big-eyed bugs and nabid bugs. Leafminer infestations began with the appearance of the first true leaves and continued to affect the younger leaves as the castor bean plants developed. By late June infestations averaging 132 miners and 111 larvae per large leaf were present. In some fields the leaf miner larvae were effectively reduced by tiny hymenopterous parasites. In 1956 seed production did not appear to be seriously affected by leaf miner infestations.

To control aphids on safflower four varieties in test plots at the Mesa Farm were sprayed with formulations of Systox (demeton), Thimet and Phosdrin. Systox, applied as a spray at the rate of one-half pound per acre, gave the most effective control. The safflower variety Pac-2 appeared least attractive to aphids of the varieties observed, while Pac-1 was most attractive.

Fly Control in Cattle Feeding Pens

During July and August 1956 seven insecticidal spray formulations were tested for initial and sustained control of flies in cattle pens at the Bruce Church Ranch near Yuma. Sprays were applied, at a pressure of 150 lbs. per square inch, to all surfaces except the inner portions of feeding troughs. Standard sprays, prepared from an emulsion concentrate of Dipterex and from a wettable powder formulation of malathion were most effective. Cumulative numbers of flies after 5 weekly examinations of sample areas (64 sq. feet for each treatment) were 47 and 82 for the areas sprayed once with Dipterex and Malathion, respectively, as compared with 780 for an unsprayed area. Malathion sprays were less effective when prepared from an emulsion concentrate than from a wettable powder formulation. Less satisfactory fly control was produced by sprays prepared from formulations of Diazinon, Tabutrex, and Compound MGK-5328.

Maintenance of Reference Collection of Arizona Insects

Approximately 50,000 labeled specimens, mostly from agricultural areas, were added to the Department of Entomology Reference Collection of Insects. Progress was made toward the more adequate housing and arrangement of this increasingly useful collection. Numerous requests for identification of Arizona insect specimens were accommodated during the year.

Work has been completed on the applied taxonomy of the following groups of insects of economic importance to agriculture in Arizona: syrphid flies, assassin bugs, blister beetles.

Cooperative Economic Insect Survey

Dr. Floyd G. Werner of the Department of Entomology continued to serve as State Clearing Agent for the U.S.D.A.-sponsored Cooperative Economic Insect Survey during 1956. With the aid of other staff members and numerous cooperators in various parts of the state, a series of weekly reports was again prepared and circulated locally under the title "Arizona Insect Notes." These reports summarized the current status of insects of economic importance in Arizona. In addition, weekly contributions and an annual summary of Arizona Insect Conditions were submitted for publication in the "Cooperative Economic Insect Report," prepared for national distribution by the Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture.

School of
HOME ECONOMICS

1. SPACE REQUIREMENTS FOR ACTIVITIES AND STORAGE FOR THE CARE OF INFANTS AND YOUNG CHILDREN.

Project Number: W-8. Funds: Hatch 323. Personnel: Faye C. Jones.

Experimental work on Part I - Space to Dress a Child - has been completed with the exception of testing a theory regarding height of the dressing table for individuals of different heights. This theory resulted from the experimental work. It is being tested now. Designs for three models of dressing tables have been developed -- Low Cost, or "Do-It-Yourself"; Space-saver; and Deluxe. Work is underway on the second and concluding part - Space to Bathe a Child. The work was to include three age groups of children - 4 to 6 months; 10 to 14 months; and 18 to 24 months. The latter was eliminated since problems were not sufficient to justify investigation except for space needed by the mother in front of the bathtub. That is being determined. The principal objective in this work is to develop space requirements for bathing arrangements that will make bathing safer for both children and mothers. A motion picture film was made of a cooperator bathing an 18-month-old child in each of three commonly used arrangements and submitted to a jury of physicians and a physicist for analysis. Out of this analysis Guides were developed for experimental work. The work which is being done at present consists of: (a) developing and testing designs for supplementary equipment aids to use in conjunction with installed and portable facilities; (b) determining requirements for counter and floor space adjacent to facilities.

Dressing and bathing are recognized as hazardous aspects of the care of young children. Findings of this project should make definite contributions to safety. They will offer designs for dressing tables which may be adjusted to the optimum working height of individuals and other safety features believed to be essential by the cooperators, designs for supplemental equipment to improve existing arrangements, space requirements for bathrooms for home planners, and conclusions regarding safe and convenient arrangements.

The experimental work should be completed during the first half of the next year and the manuscript and final designs prepared by the end of the year.

2. THE EFFECT OF WARM CLIMATE ON BASAL METABOLISM AND BLOOD SATURATION LEVELS OF ASCORBIC ACID.

Project Number: 370. Funds: State and Hatch. Personnel: Ethel M. Thompson.

Finger tip blood of four women was analyzed during winter and summer and of two others during winter only. Ascorbic acid intake was kept nearly constant by means of the dietary which contained from 7 to 13 mg. and the crystalline vitamin of which 0.4 mg./kg. body weight was given daily. Basal metabolism was determined several times each season. Temperature and relative humidity were recorded daily.

There appears to be a marked difference in the rate of loss of ascorbic acid between the two seasons which may vary among individuals. The change was non-linear with loss being high at first, then gradually diminishing to a relative minimum close to 0.5 mg.% of serum. Average daily loss was much greater in summer than in winter; the minimum being reached much sooner in summer but both remaining at nearly constant levels thereafter. Using the same functional relationship for the two seasons, regression and correlation coefficients were found to be much higher in winter indicating either a wider daily variance in summer or a different functional relationship between the two. Comparison for individuals in both periods and for the average of all cases in each period yielded significant differences among the regression coefficients. Basal O_2/cc/minute was 10 to 13% lower in August than in winter.

If completion of the examination of the data of all six subjects should confirm the finding that vitamin C is lost from the blood more rapidly in summer than in winter, it should be of importance to the health of all people living in hot climates. It should increase the demand for the important crops of Arizona such as lettuce, other green vegetables, cantaloupe and citrus fruit, all of which are rich in this vitamin.

Examination of the data so far indicates that the rate of loss of the vitamin may be different among individuals. This was found to occur in subjects of this study, not all of whom were of the same age range. It is proposed that influence of age be further investigated using subjects to be selected from three age groups, namely, the early, middle, and older adult years. Later a study of the rate of loss in certain diseases should be made.

3. THE RELATION OF WARM CLIMATE TO BASAL METABOLISM AND BLOOD CHOLESTEROL.

Project Number: 420. Funds: W-44. Personnel: Ethel M. Thompson, Mary A. Kight (Technical Worker).

Incidence of atherosclerosis, together with hypercholesteremia, has been shown to be increasing steadily in this country. Factors which can be demonstrated to affect the level of serum cholesterol, or to be associated with it, are therefore of special interest to investigators of this disease.

High serum cholesterol occurs with low basal metabolism (B.M.) as is observed in hypothyroidism. In a study in 1948 of girls and young women native to southern Arizona, with its relatively long annual hot season, the writer found a B.M. of -14 to -17% when compared with commonly used standards elsewhere. Tests were not made in the summer months which, it is expected, would have been even lower. It is suggested that an analysis of serum cholesterol of these subjects may have shown values above normal.

It is now a practice in many clinics to substitute determination of protein-bound iodine (P.B.I.) for B.M. Some workers state that P.B.I. is a more reliable index of thyroid function than B.M., others that it be used only when a measure of B.M. is impractical. It becomes of special interest, therefore, to determine B.M., P.B.I. and serum cholesterol and correlations.

Blood serum of young women living in southern Arizona throughout the year is being analysed for total cholesterol and P.B.I. and their correlation. B.M. and its correlation with these blood constituents is being determined. Analysis for total cholesterol is being made by the method of Pearson, Stern and McGavack as modified for the micro procedure by Adamson. P.B.I. is being determined by the method of Barker, Humphrey and Soley as modified by Ware, Grillhoesl and Grant. At present, three subjects being used for these analyses are young college women who have had physical examinations including complete blood counts and urinalyses. Preliminary B.M. tests have been made. A total of six subjects are to be studied throughout the seasons of the year for the purpose of determining variations in the two constituents and B.M.

Department of
HORTICULTURE

1. THE BREEDING AND IMPROVEMENT OF MELON VARIETIES ADAPTED TO ARIZONA.

Project Number: 295. Funds: Federal. Personnel: R. E. Foster, L. Burkhart, L. G. Houck, G. Sharples.

Summary: A. 110 strains of muskmelon tested in two commercial fields. Crown blight susceptibility evaluated by leaf-count method. Five-hundred-sixty-six foreign introductory strains evaluated for crown blight reaction and other characteristics. None showed resistance to crown blight. B. With USDA cooperative funds, double breeding program carried out during the spring and fall. Emphasis was placed on breeding for crown blight resistance. One thousand strains grown to maturity were used for breeding, then rated for crown blight susceptibility. Using rating scale, 0 = no crown blight damage, to 5 = completely killed, standard PMR 45 var. = 3.0. In breeding program, more strains gave readings of 2.5 or less than gave 3.5 or more indicating progress in over-all selection for resistance. Two of older families = 2.0-2.5, third established families average reading of 2.0, fourth consistent at 1.5-2.0. Several new stocks selected with susceptibility ratings of 0.5-1.5 and another group maintained at 1.0-2.5. A uniform and consistent rating of 1.0 or less considered necessary for commercial resistance to the disease. Fall program revealed three strains apparently completely resistant to aphid attack. Besides disease and insect resistance, stocks were selected for yield, fruit size and desirable fruit characteristics. C. Arizona Sunrise and two crown blight resistant strains seed increased. Muskmelon seed certification program in full operation.

Disease resistance with only crown blight control to date. Intensified breeding program shows resistance to crown blight is increased by crossing, selection and selfing - this very slowly, but progress is being made toward development of crown blight resistant strain for Arizona. Seed certification program to provide growers with high quality Arizona Sunrise seed. This variety promising for fall cantaloupe crop as well as for early spring production.

Sub-Project: Varietal Responses of Cantaloupe to Changes in Ratio of Calcium and Magnesium Ions in Nutrient Media. (USDA cooperative funds.)

In December, 1955, controlled nutrition studies of three varieties of cantaloupe were begun in the greenhouse. Young plants were grown in quartz sand and fed nutrient solutions of varying composition daily. Plants were also grown in soil which had been leached with electrolytes so that the exchange complex was saturated with Ca and Mg ions in varying ratios. These tests revealed that the ratio of Ca ions to Mg ions was extremely important to plant health. In general, whenever the Ca/Mg ratio in the nutrient medium is too high, symptoms often develop which are in many respects similar to those of Crown Blight. Potassium level also influenced the severity of damage in sand cultures, but could not be shown to be of significance in soil cultures. The pattern of varietal susceptibility to Crown Blight in the field is identical to that of damage due to high Ca/Mg ratios in the greenhouse tests. Field experiments in which magnesium chloride was added to the soil in an attempt to reduce the Ca/Mg ratio were inconclusive. Most recent greenhouse experiments tend to show that nitrogen nutrition is an important factor in the crown leaf injury of cantaloupes. If this is true, perhaps methods and amounts of N fertilization for optimum

growth need to be re-evaluated Nitrogen also apparently influences the type and amount of crown leaf damage which is caused by high Ca/Mg ratios. This theory is currently being investigated. All treatments and observations of symptoms and growth are being correlated with plant composition by means of tissue analysis.

It is felt that the origin of the Crown Blight problem lies in an obscure combination of nutritional, water, and genetic deficiencies. An intelligent approach to the solution is impossible without a supply of fundamental information which these studies provide.

2. CULTURAL FACTORS AFFECTING CANTALOUPE PRODUCTION IN ARIZONA.

Project Number: 296. Funds: Hatch. Personnel: W. D. Pew, Laurel Leavitt, L. Burkhart.

I. Effects of rates and sources of nitrogen on the growth, yield and incidence of crown blight.

This test was initiated in order to accumulate information and data relative to the effects of certain nitrogen sources on the growth, yield and incidence of crown blight on cantaloupes. Four sources of nitrogen were used. These were: calcium nitrate, urea, ammonium nitrate, and ammonium sulfate. Each of these sources was applied at 60, 120, 180, and 240 pounds of actual nitrogen per acre. A check plot was used as a basis for minimal comparison.

The fertilized plots, regardless of source or amount, produced greater yields of both 45 and 36 sized melons than the check. The most desirable rate appeared to be between 120 and 180 pounds of actual nitrogen. Without exception, the 240 pound rate for all fertilizers produced fewer marketable melons than did the 120 and 180 pound rates. The 60 pound rate, regardless of source, appeared to be insufficient to produce maximum yields. Vine growth was decidedly poorer in the 60 pound rate plots. This was particularly noticeable late in the season. Excellent vine growth, color, and vigor was obtained with all the fertilizer sources at the 120, 180, and 240 pound rates. There appeared to be no detectable difference in the quality of the fruits regardless of source or rate of nitrogen.

From observations and leaf count, no difference in incidence of crown blight was evident. It should be pointed out that the unfertilized plots developed the typical nitrogen shortage symptoms but did not show any increase in dead leaves when compared to the fertilized plots. This nitrogen deficiency appearance occurred relatively early and persisted throughout the remainder of the test.

The reported evidence supports earlier findings that the source of nitrogen makes no difference in the appearance of the plant or in the yield of the fruits. Whether or not nitrogen is a contributory factor in the incidence of crown blight continued to be questionable from this information. It appears that cantaloupe should be fertilized with more than 60 pounds actual nitrogen but should not have more than about 180 pounds of nitrogen for maximum yields.

II. A study to determine the effects of varying levels of water, tillage treatments, and nitrogen on the incidence of crown blight disease on three standard varieties.

The test was designed to provide information concerning the major effects of variety, irrigation, tillage, and nitrogen. In addition, any existing interactions or relationships among the listed variables could also be measured.

Notes made from early observations indicated some early differences did exist between the various tillage treatments. However, these differences became less noticeable as the test progressed. The test was complicated by the fact that the speed of decline--supposedly crown blight--was delineated by block or replication and not by treatments. No attempt has been made to explain this unorthodox reaction. Some difficulty was experienced in getting irrigation water at the specified time to fulfill the various irrigation requirements. This may have been a factor affecting the lack of response to the varying irrigation levels.

Although leaf counts and other data were collected, there was so much variability in the data that no important trends or results can be reported at this time.

The findings are too inconclusive and variable to indicate any specific suggestions or recommendations.

III. Effects of certain green manure crops and feed lot manure on growth and yield of cantaloupes.

To determine the effects of papago peas (a winter green manure crop), guar (a summer green manure crop), alfalfa (a perennial type green manure crop), and the application of feed lot manure on cantaloupe production.

Early observations indicated a rather marked improvement in the early vine growth where feed lot manure was used. This did not prove to be an advantage if expressed in yield. This is shown by the yield figures in Table 1 below. Some early improvement in melon vine growth was noted where melons followed a guar crop as a green manure. In all cases, the plants grown on the check plots were less vigorous than the plants grown on the other treatments. It should be pointed out that this crop was grown three seasons following the 20-ton application of manure. This may account for the poorer growth and yield from these plots as compared to previous years' results where large differences were recorded.

TABLE 1. Effects of Papago Peas and Steer Manure on the Production of Cantaloupes.

Treatment	Total Yield Crates/Acre		
	36 size	45 size	Total
Papago Peas	33.0	71.0	104.0
Steer Manure (20 T/A)	25.0	81.0	106.0
Check	25.0	72.0	97.0

A comparison of the above data with previous years' results would indicate that applications of feed lot manure tend to run out after about three years of continuous cropping to head lettuce and cantaloupes.

IV. Effects of varying soil moisture levels on cantaloupe growth, yield, and incidence of crown blight.

The test was designed to determine the effects of varying soil moisture levels maintained by furrow irrigation on growth, yield, and incidence of crown blight.

Uniform planting was made using the standard PMR No. 45 variety. After planting, the field was given the germination irrigation and one additional irrigation to bring about the desired stand. Thinning was accomplished at the 2 to 4 true leaf stage. On June 6 the last uniform irrigation application was made. Each treatment was then watered as the need was indicated by the soil moisture measuring instruments placed in the beds.

Noticeable difference in vine vigor began to become apparent and observable differences in plant color began to show up about July 1. Plants in the low moisture plots were darker green in color and were growing much slower than the plants in the other plots. In this respect, there appeared to be somewhat of a linear effect in plant growth progressing downward from the very wet to the very dry plots. The plants being grown on the very wet plots continued to grow vigorously and remained lush throughout the growing season.

Plants on the very wet plots produced the greater number of marketable fruits. In addition, there was a higher percentage of the 36 size melons and a smaller percentage of the 45 size melons. The very dry plots gave the poorest yield and had fewer 36 size melons than any of the plots. Likewise, the check plots had the highest percentage of 45 size fruits.

The total count of dead leaves of plants selected at random indicate that plants in all treatments were about the same. However, the rapid growth of the plants grown on the wet and very wet plots appeared to cover and thus mask the dead older leaves. This was not true of the drier plots.

The data indicate that irrigation procedures may be a contributing factor in the visible amount of crown blight because of the masking growth pattern resulting from it. Improved yields and particularly of the larger 36 size fruits came from the wet and very wet plots. The results on the crown blight effect are not conclusive enough to warrant a direct statement at this time.

3. LETTUCE BREEDING IN ARIZONA.

Project Number: 297. Funds: Federal. Personnel: R. E. Foster, L. Burkhart, L. G. Houck.

A. To devote more of facilities to the breeding program, no variety tests were made this year. Standard varieties were used for comparison in the breeding plots. B. Several hundred breeding strains selected and carried to seed in spring. Evaluations of these indicated in many of these, variation had been reduced to the point where mass seed production could be started. This was done in the fall with large plantings of selected strains. These have been and will be maintained with strict roguing. Some entire blocks discarded as of less desirable type. Seed to be harvested in mass in sufficient quantity to permit field scale testing next season. Selection of stocks on basis of internal characters of heads continued for development of resistance to rib discoloration

and tip burn. Program also continued with individual plant selections and selfing. C, D. Renewal of foundation stocks of Arizona 44 and Arizona 615 accomplished by strict roguing on Experiment Station land. Seed certification program remains active with the production on commercial grower fields of certified seed of three approved varieties.

Breeding strains now under mass seed production give considerable promise, especially for new early fall and new late spring varieties of "Imperial" type shipping lettuce. Extension of the season of adaptability for high-quality Imperial type will enable it to compete favorably with lower quality Great Lakes strains now used. This will improve quality of the produce from Arizona. Strains show some resistance to tip burn and rib discoloration.

4. CULTURAL FACTORS AFFECTING HEAD LETTUCE PRODUCTION IN ARIZONA.

Project Number: 298. Personnel: W. D. Pew, Laurel Leavitt, L. Burkhart.

NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR: Effects of Certain Green Manure Crops and Feed Lot Manure on Growth and Yield of Head Lettuce. To determine the effects of papago peas (a winter green manure crop), guar (a summer green manure crop), alfalfa (a perennial type green manure crop), and application of feed lot manure on head lettuce production.

A summary of the data show that guar as a green manure crop is not as effective in improving lettuce yields as is feed lot manure at 20 tons per acre even three years following the manure application. Yield increases from the manure treatment were the result of both a higher percentage of larger, more desirable sizes and a higher percentage of cut. Earliness was also markedly influenced by the manure application. Yields and quality of the lettuce grown on the guar plots was generally poorer than that grown on the manure treated plots. The yield on the check plots was significantly poorer than for the lettuce grown on both the guar and steer manure plots.

Soil condition and water intake was better on the green manure and feed lot manure plots as compared with the check.

TABLE 1. Effects of Guar and Steer Manure on Production of Head Lettuce.

Treatment	Harvests		
	1st	2nd	Total
	2 Dozen Size - Cartons Per Acre		
Guar	83.0	364.0	447.0
Steer Manure (20 T/A)	192.0	348.0	540.0
Check	32.0	212.0	244.0

APPLICATION OF FINDINGS: The data show that the use of high quality feed lot manure improves the yield and earliness of head lettuce. Its use also has a very beneficial effect on the soil condition and maintenance of good tilth. Guar was effective also but not to the extent of feed lot manure. Consequently, where

available, manure is recommended over the use of the green manure crops studied. If feed lot manure is not available, green manure crops will effectively improve head lettuce production. The market value of the various sizes at harvest time would be the controlling factor concerning monetary gains that could be derived from the use of materials in the better treatments.

WORK PLANNED FOR NEXT YEAR: To be continued as originally set up to determine the relative values of certain green-manure crops and feed lot manure in head lettuce production. Also to determine their residual effects in crop production and soil condition.

5. FACTORS AFFECTING PRODUCTION OF CITRUS IN ARIZONA.

Project Number: 299. Funds: Hatch and State. Personnel: R. H. Hilgeman; L. Burkhart, C. W. Van Horn, T. A. Hales and G. C. Sharples.

A. SALT RIVER VALLEY

1956 Climatic Season. Temperature during January continued the pattern set in December with temperatures running 6-15 degrees above normal. Late January rains were followed by freezing conditions on Feb. 3 and 4 when temperatures of 23.5° F. occurred with a duration of 3½ hours below 26°. Slush ice formed in Valencia oranges in unprotected areas but drying failed to develop. No injury to leaves or twigs occurred although heads were swelling and a few small shoots had started growth. Below normal temperatures with occassional light rains, prevailed during February. Early March temperatures were above normal so that new growth had started and was about 1 inch long when a sharp freeze occurred on March 13. Temperatures dropped to 25° F. with a duration of six hours below 32°F. and one hour below 26° F. The new growth was not injured.

Unseasonably warm weather followed the freeze. Blossoming of the same varieties varied in different blocks with the Washington Navel in full bloom between April 4-10, and Valencias and grapefruit between April 9-14. Temperatures well above normal continued throughout April and May with maximum temperatures above 100° F. on seven days between May 16-24 (max. temp. 110° May 17). Temperatures above 106° occurred between May 31-June 4 (107°max) June 9-June 14 (113° max), July 6-12 (113° max.) Aug. 6-8 (109° max) Sept. 4-7 (107° max) Sept. 11-13 (108° max.). Between these intervals normal or below normal temperatures prevailed, summer rains were far below normal with only three light shower periods in July and August.

Damage from cottony cushion scale to grapefruit was highly variable. Insects appeared in April but spreading was spotted. Certain trees were seriously infested, twigs died and the leaves turned a spotted yellow color. This bad condition developed entirely on trees in the centers of the blocks which suggested that the spray drift from the adjoining cotton fields did not influence the vedalia. Vedalia beetles were present from June to October but a complete clean up of scale did not occur until late October.

Spring growth of trees was profuse with unusually large leaves. Short growth occurred irregularly throughout the summer and was about normal. Fruit set was below the previous two years with growth of navels about normal or slightly depressed. Valencia fruit growth was more rapid than has been measured in any previous year, whereas grapefruit growth was the slowest ever recorded.

Abnormally high temperatures were maintained throughout September until Oct. 25 when a light frost occurred. Moderately warm temperatures were followed by killing freezes on Nov. 2, 3 and 4 (28° min) which slightly injured leaves and twigs. Slightly above normal temperatures again prevailed until 20 when a sharp freeze of short duration occurred (min temp. 23° with 1 hr. below 26°). Slight to moderate injury to leaves occurred on lemons, small trees, and grapefruit (5-20% defoliation). Small nursery trees were killed or seriously damaged.

Drying winds did not occur during the fall and almost no losses from mesophyll collapse occurred.

Orange maturity was early with picking beginning about Nov. 6. Grapefruit quality in the fall was only fair but picking started Nov. 6.

Temperatures slightly above average prevailed in December, with freezing conditions on Dec. 24 when a minimum temperature of 23°F. occurred with 5 hours below 26°. Slush ice developed in occassional small outside fruits, but drying did not follow and an economic loss did not occur.

Varieties: In October 1956 budwood of the Warren and Frost Nucellar Navel varieties which had been indexed for Treteza were imported from the Willets Newcomb grove and the U.S. Date Garden at Indio. Buds were placed in about 600 Cleopatra mandarin seedlings growing at the U of A Citrus Expt. Station near Tempe.

Rootstock Trials: The first crop of Lisbon lemons was harvested on Nov. 5, 1956 from trees planted in March '52. Yields were also obtained from the cooperative rootstock planting at Rancho Santa Maria made in 1952 with similar trees. Slightly higher yields were obtained at the Citrus Experiment Station than at Rancho Santa Maria, despite the very serious damage to the former trees by the 1954 freeze. Significantly higher yields were obtained from trees growing on Citrumelo, Rangpur lime and Rough Lemon rootstocks, than from trees growing on Florida sour orange, Troyer citrange, Koethen Sweet orange and Wilking mandarin. Rough Lemon root significantly reduced the total soluble solids in the fruit and tended to reduce the acid; other rootstocks did not affect fruit quality. No significant effect upon juice content or peel thickness occurred. (Table 2).

TABLE 2

Effect of Rootstock on Tree Growth, Fruit Yield and Quality of Lisbon Lemon

Rootstock	Trunk Area Sq. Cm.		Yield Fr. per tree		Quality (a)				
	Cit. Expt. Sta.	R.S.M.	[b]Cit. Expt. Sta.	R.S.M.[b]	Citrus Expt. Station T.S.S. %	Acid %	Juice % by Vol.	Juice % by Wt.	Peel Thick. mm
Citrumelo	90	89	540	330	9.3	6.01	41	47	3.9
Rangpur Lime	90	90	526	338	9.5	5.96	42	47	3.8
Rough Lem.	102	102	470	449	8.7	5.73	43	49	3.6
Okla. Sour	84		408		9.6	6.04	42	48	3.7
Flor. Sour	84		306		9.4	5.91	42	48	3.9
Troyer Ctgn.	80	97	294	241	9.2	5.81	43	45	3.9
Koethen Swt.	75	103	258	275	9.4	5.98	43	48	3.7
Wilking Man.	64		139		9.4	5.98	41	46	3.7
Statis. Sig.	xx	x	xx	xx	x	NS	NS	NS	NS
LSD p- .05	13	11	90	121	.41				

(a) Fruit tested on Oct. 29, 1956
(b) Rancho Santa Maria
(c) At Rancho Santa Maria-Sweet Orange root is Casa Grande Sweet Orange

Irrigation of Valencia Oranges: Irrigation has affected fruit sizes but the size of the crop in relation to the capacity of the tree to produce fruit also is a factor influencing fruit size. This is well illustrated in the yields during 1953, 1954 and 1955.

During these years the yields from plots C and F which are respectively dry all year and dry in the spring and wet in the fall, have alternated widely; whereas, more constant yields have been produced on the trees which receive ample water all the time or are dry in the fall. These variations in yield have influenced fruit size (Table 3).

TABLE 3

Yields and Fruit Size in Relation to Irrigation Treatment

	A High Moist	B Mod. Moist	C Low Moist	D Alter row Moisture	E Wet Spr. Dry Fall	F Dry Spr. Wet Fall	LSD
1953 Yield(a)	722	709	561	840	746	602	72
% Size 110(b)	59	62	47	46	42	59	7
1954 Yield(a)	813	719	373	754	912	305	103
% Size 110(b)	61	71	80	68	41	81	15
1955 Yield(a)	813	791	627	718	816	630	119
% Size 110(b)	83	76	75	72	73	72	ns

(a) Yield in fruit per tree.
(b) Percentage of crop carton size 110 and larger.

In 1953 when yields in all plots were relatively high inadequate irrigation reduced sizes as is illustrated by plots C, D and E. In 1954 when lower yields occurred on the C plot larger size fruit was produced than developed on the heavily irrigated A Plot. In 1955 while significantly lower yields occurred in the C plot trees the yields are considered to be high for the size of the tree and a significant difference in fruit size did not occur.

EFFECT OF CHELATE SPRAYS ON YIELD OF CITRUS

One pound of each of the following compounds: Na_2Zn EDTA, Na_2Mn EDTA and NaFe DTPA were combined in 100 gallons of water and sprayed on trees on either March 12 '56 and April 14 or on each date. A second spray made up of 2 lbs. $MnSO_4$ and 6 lbs. of citric acid per 100 gallons of water was applied shortly after blossoming on April 16. Nine trees of Grapefruit and Valencia orange and six trees of healthy Washington Navel trees were sprayed with one or more of the above combinations.

EFFECT OF CHELATE SPRAYS ON NUMBER OF FRUIT SET PER TREE

	Zn Mn Fe Mar.	Zn Mn Fe Apr.	Zn Mn Fe Mar.&Apr.	Mn-Cit. Apr.	Cont.	Sig.
Grapefruit (Ave. 52-55)	434	433		461	445	ns
'56	284	290		291	323	ns
% of Ave.	68	68		64	73	ns
Wash. Nave. (Ave. 52-55)			355		375	ns
'56			240		323	ns
% of Ave.			68		86	ns

Production in 1956 was very much reduced over the previous year and also below the average for the previous four years. There is no evidence that the sprays had any beneficial effect on fruit set. In fact the tendency in all spraying tests used during 1956 which have been evaluated to date suggests that the sprays may exert a harmful effect.

6. LETTUCE SHIPPING QUALITY AND CONSUMER ACCEPTABILITY AS AFFECTED BY VARIETIES, GROWING CONDITIONS AND PACKING.

Project Number: 308-A. Funds: Federal. Personnel: L. Burkhart, G. Sharples, L. Houck, R. Foster.

Physiology and biochemistry of lettuce tissues in relation to "rib discoloration". Physiological and biochemical characterization of sap extracts of lettuce tissue is being carried out in an attempt to discover a physiological basis for the condition in head lettuce known as "rib discoloration". Polyphenolic compounds found in the tissues have been determined quantitatively and it is desired to attempt to measure the activity of the enzyme polyphenol oxidase under varying conditions. To this end, methods have been studied during the past year with intention of studying possibilities of application to the problem. Of available methods, the chronometric technique appears most useful and convenient. Preliminary measurements using the chronometric method are now being made to arrive at adequate sampling and handling methods. The possibility of freezing for holding samples for analysis is being investigated.

All work on this disease of head lettuce is directed at finding the cause and a subsequent control. Physiological and biochemical facts learned in these studies may aid in this search.

7. MELON AND CARROT SHIPPING QUALITY AND CONSUMER ACCEPTABILITY AS AFFECTED BY VARIETIES, GROWING CONDITIONS AND PACKING.

Project Number: 308-B and 308-C. Funds: Federal. Personnel: L. Burkhart, G. Sharples, L. Houck, R. Foster.

SUMMARY: Melons: In connection with the recently developed Arizona Sunrise cantaloupe it has been observed that the variety has good consumer acceptance. However, there is need for more specific information on the proper stage of maturity for successful shipping and appropriate shelf life of the variety. Preliminary observations indicate that this variety requires more attention to harvesting for shipping before green ground color disappears. If allowed to fully ripen on the vine the seeds easily shake loose on handling and during shipment the flesh becomes water soaked in appearance.

Carrots: Post harvest handling continued toward film packaging and further research is planned in line with this trend.

The increased use of the Arizona Sunrise cantaloupe by growers will depend upon more maturity information for guidance in proper harvesting for improved shipping quality and consumer acceptance. Carrot production in Arizona must successfully compete with other areas in film packaging and more information developed in this connection will aid carrot producers in shipping a superior product.

8. CARDINAL GRAPE IMPROVEMENT.

Project Number: 343. Funds: State. Personnel: R. H. Hilgeman, H. J. Phillips.

Studies were made of the quality of Cardinal and Thompson Seedless grapes from 685 and 152 tests respectively on two bunch samples at the time of packing the fruit.

Harvesting of Cardinal grapes started on June 13 at the Arrowhead Ranch and all growers were harvesting fruit by June 20. Shipping ended between July 9 and 13. The percentage of soluble solids were generally at a high level. Fifty-one per cent of the early picked fruit and 71% of the fruit harvested after July 5 passed 16% solids. The acid was slightly lower than it was in 1955. Ninety-nine per cent of the fruit at all times during the season had less than 1% acid. The acid content of the late ripening fruit was similar to the early ripening fruit. This represented a wide deviation from all previous years when late picked fruit contained less acid.

Harvesting of Thompson Seedless grapes began on June 24 and extended through July 14. Eighty-three per cent of the early picked grapes and 97 per cent of the late picked fruit had 16% solids or higher. The acid content of early fruit was higher than that of the Cardinal grapes in that only 66% of the early fruit had 1% or less acid. All late harvested fruit had less than 1% acid.

Under the previously suggested maturity standard of 16 per cent solids or a 16:1 ratio, a closer check would have had to be kept on picking crews in 1956 to prevent picking of Cardinal fruit low in solids. These tests are being made primarily to build up a history of crop maturity so that data will be available should it be necessary to enact a grape maturity low.

9. DECIDUOUS FRUIT VARIETIES.

Project Number: 344. Funds: State. Personnel: L. Burkhart, S. Fazio, J. Folkner.

The present testing program of deciduous fruit varieties at Mesa has been underway since 1949. Undesirable varieties have been replaced with new more promising introductions. Superior peach varieties: Springtime, Lammerts' selection, Robin, Meadowlark, Blazing Gold and Early Elberta ripening late May to mid-July. Superior apricot varieties: Blenheim, Royal, Earligold, maturing late May to mid-June. Superior plum varieties: Beauty, Hollywood (attractive foliage), Red Rosa, Mariposa, Duarte and Santa Rosa; the plums were harvested in July except Beauty harvested in June. Superior grape varieties: Cardinal, Flame Tokay, Perlette, Red Malaga, Thompson Seedless. New peach planting established at Safford Experiment Farm using the superior varieties proven at Mesa and others with possible adaption to the higher elevation.

Interest expressed in new commercial deciduous fruit plantings in the Salt River Valley, Tucson area and Safford point to information needed on better adapted varieties for specific market conditions.

10. VEGETABLE VARIETY TESTING AND BREEDING.

Project Number: 345 and 346. Funds: State. Personnel: R. E. Foster, L. G. Houck, R. A. Nelson.

Most of the activity on this project was confined to the testing of sweet corn varieties during both the spring and fall seasons. Both crops are possible commercially in Arizona, but varietal requirements differ for the seasons, especially in regard to insect tolerance. Consequently considerable attention was paid to insect damage on the 20 plus varieties under test. In addition, yields, size and numerous quality factors were evaluated for each strain in each location. Certain strains new to Arizona continue to outyield standard strains and in some quality characteristics are more desirable. This confirms first-year results obtained previously.

A cooperating program was developed with New Mexico for the certification of onion seed in Arizona. Rules and regulations were formulated and the program was started with the planting of three fields of foundation stock for seed increase.

Activity on other crops in this project was suspended to permit greater emphasis on crown blight studies with muskmelons.

11. VEGETABLE CULTURE TESTING.

Project Number: 347. Funds: State. Personnel: W. D. Pew, Laurel Leavitt, H. Fred Arle and G. Neil McRae.

Weed Control in Onions - The effects of several herbicides on growth and production of bulb onions and the weeds associated with this crop: This test was initiated, and has been continued, to develop methods for controlling weeds in a commercially grown bulk or dry onion crop which would be more effective and with less expense than those currently used.

Treatments were made as pre-emergence applications after seeding and prior to the first irrigation. Certain other treatments were also made when the seedling onions were in the "flag" stage of growth.

The pre-emergence application was made November 14, 1955.

The post-emergence application was made December 15, 1955.

TREATMENTS:

1. Check
   Pre-emergence
2. CDAA 5.0 lb/A
3. CDEA 5.0 lb/A
4. CDEC 5.0 lb/A
   Post-emergence
5. CDAA 5.0 lb/A
6. CDEA 5.0 lb/A
7. CDEC 5.0 lb/A
8. H_2SO_4 5% Sol, 50 GPA
9. H_2SO_4 5% Sol, 100 GPA
10. H_2SO_4 10% Sol, 50 GPA
11. Aero Cyanate 12.0 lb/A
12. M-213 1.0 lb/A
13. Kuron 1.0 lb/A
14. 2 Methyl 4 chlorphenoxy propionic (ester) 1.0 lb/A
15. Diuron 1.0 lb/A
16. HC 1281-S 1.0 lb/A
17. Geigy 444 8.0 lb/A
18. CIPC 4.0 lb/A

A measurement of the decrease in weed growth as determined by a reduction in hand labor weeding time was obtained. Estimates of plant growth, vigor, onion yields and grade of onions were made.

Pre-emergence applications of CDAA and CDEA slightly retarded date of emergence, but had no adverse effect on the final onion population. On the other hand CDEC caused a very definite delay in emergence and seriously reduced the stand. Both CDAA and CDEC provided excellent weed control for about 6 weeks after which various species of lambs quarters, malva and wild lettuce emerged and began to grow. Control of wild mustard continued to be good. Best weed control was obtained on plots treated with CDEC. However, this material caused a highly significant reduction in yield. CDEA appeared least toxic and caused the least reduction in yield of any of these materials. When CDAA, CDEC and CDEA were applied as a post-emergence application (onions in the flag stage), there was no evidence to indicate that vigor or onion development were affected. Applying the materials in this manner provided fair weed control. Applications of sulfuric acid caused a temporary stunting of the onion plants. An application of Aero Cyanate gave good control of annual broadleaf weeds. Propionic acid formulations were injurious, also Geigy 444 and Diuron. CIPC gave very good weed control.

Findings indicate that some of the newer herbicides show promise but should be studied further. The standard treatments of Aero Cyanate and Sulfuric Acid still appear relatively effective.

Project to be continued to screen and evaluate newer materials in an attempt to find a better and less expensive means of weed control in onions.

12. CULTURAL MANAGEMENT OF BERMUDA LAWNS.

Project Number: 348. Funds: State. Personnel: S. Fazio.

Bermuda grass lawns in a low state of fertility show a tendency to develop numerous seedstalks. The condition has been remedied by fertilizing frequently with ammonium sulfate, ammonium nitrate or ammonium phosphate. The use of ammonium phosphate as the sole fertilizer has a tendency to produce more seedstalks than those lawns fertilized with straight nitrogen compounds. The color and vigor of lawns fertilized with ammonium phosphate and straight nitrogen fertilizers do not show any appreciable differences except in the formation of seedstalks. U-3 strain of Bermuda shows no advantages over common Bermuda.

Observations indicate an increase of seedstalks formation when ammonium phosphate is used continually. Straight nitrogen fertilizers applied to Bermuda grass result in fewer seedstalks.

13. TEMPERATURE RELATIONS IN HORTICULTURE.

Project Number: 353. Funds: State. Personnel: S. Fazio.

Monthly lettuce plantings of Great Lakes, Imperial 44, and 615 in Tucson are in the 3rd year of testing. Rib discoloration patterns were similar to previous plantings in that it occurred during frost free periods and also after frost periods when flower blooms of other plants have been killed. Young lettuce in the early folding stage contained the largest numbers of thrips in comparison to older lettuce plantings. Symptoms of rib discoloration appeared in lettuce as it approached firm head stage. Light tan streaks developed in the succulent mid-rib section of the leaf in the early stages of infection and these became progressively darker and sunken in the later stage of development. Great Lakes appears to be more susceptible to rib discoloration than the Imperial strains as evidenced by the greater number of heads showing rib discoloration. A light infestation of rib discoloration occurred in the September plantings. Thrips were feeding heavily on wild mustard growing in the lettuce planting. Counts made of thrips in the lettuce plants indicated a low population of this insect. Migration from mustard to lettuce began after the lettuce heads had formed. Plots dusted at regular intervals with 10% DDT showed 50% less rib discoloration than those plots with no insecticide applied.

Ecological factors related to the occurrence of lettuce rib discoloration appear to include residential areas adjacent to lettuce fields, with particular reference to flowering plants serving as hosts for thrips.

Seasonal temperature effects on Great Lakes and Imperial types of lettuce have been observed on monthly plantings made at Tucson. The winter season 1956-57 has been the warmest during the four years of the testing.

Rib discoloration of lettuce plants in test plots located in Tucson continued to show the same pattern of symptoms for the fourth year. Initial symptoms begin with light tan streaks in the basil leaf section and become darkened and sunken as the plants reach the commercial head stage. Plots dusted with chemical DDT to control insect pests have 50% less rib discoloration than the non-treated plots. Heads in the treated plots show less sliming and the streaking of the mid-rib section is less prominent than the check plots.

Prior observations indicated a possible biological relationship of insect population, flowering plants, and rib discoloration in residential areas. Symptom patterns and control of insect pests associated with rib discoloration is suggested from results obtained during the past three years.

14. SOIL MOISTURE MOVEMENT FACTORS IN THE ROOT ZONE OF CROP PLANTS AND EVAPORATIONAL EFFECTS.

Project Number: 371. Funds: Hatch and State. Personnel: R. H. Hilgeman and T. A. Hales.

Plots were pre-irrigated on June 22 and appropriate plots planted to hegari on June 28, or hoed. Non-evaporation plots were sealed with tar paper immediately after irrigating. Between June 28 and Sept. 20 loss of moisture from

the upper six feet of soil was as follows: Hegari plots 7.26 inches, bare plots 4.93 inches, covered plots 2.86 inches. The root zone extended from 6 to 48 inches. Significantly larger amounts of water were lost from the 0-6, 6-12 and 12-24 inch depths in the evaporation plot than in the covered plot.

Soil around a Valencia orange tree was covered after irrigating and loss of water to five feet compared with bare soil. Loss of water from the supper 24 inches during the 12-day period after irrigating (Aug. 15- Aug. 27) was about 30% greater from the bare plot with highly significant larger losses from 0-6 inche zone.

15. WEED CONTROL IN VEGETABLE CROPS.

Project Number: 374. Funds: Federal. Personnel: W. D. Pew, Laurel Leavitt, L. Burkhart, (H. Fred Arle and G. Neil McRae, ARS, USDA).

Effects of certain herbicides on the control of Purslane in head lettuce. This sub-project was initiated in an attempt to find a chemical that would control purslane in field grown head lettuce without injury to the crop.

Area was treated August 21 immediately after seeding and just prior to the germination irrigation. All treatments were applied pre-emergence. Temperatures at application time were approximately 100°F.

TREATMENTS:

1. Check
2. 2-(2,4,5-trichlorophenoxy) propionic acid, M-213 1.0 lb/A
3. Isopropyl N-(3-chlorophenyl) carbamate, CIPC 10.0 lb/A
4. CIPC 15.0 lb/A
5. Chloro-N,-diallylacetamide, CDAA 5.0 lb/A
6. Chloro-N,-diethylacetamide, CDEC 5.0 lb/A
7. Sec-Butyl N-(3-chlorophenol) carbamate, N 5519 4.0 lb/A
8. 2-Chloroallyl diethyldithiocarbamate, CDEC 5.0 lb/A

Crop was harvested November 13, 1956 (1st cut) and December 6, 1956 (2nd cut).

Materials were applied in 40 gal. of water per acre with a 3 gal. pressure sprayer. A teejet 8003 nozzle was guided directly over the seed rows in application. Pressure was 35 p.s.i.

1) The use of M-213 temporarily inhibited the growth and development of lettuce during the early stages of growth. These plants recovered and were normal at harvest time. The purslane population was slightly reduced. 2) The application of CIPC at 10.0 and 15.0 lb/A practically eliminated purslane but caused a marked reduction in lettuce emergence and slowed growth of the surviving plants. (It was found in another test that 5.0 lb/A gave almost as good a control of purslane with much less effect on the lettuce crop). Results: N 5519 were similar and it reduced yields. 3) Applications of CDAA and CDEA had no apparent effect on emergence or lettuce development but also proved non-effective against purslane. Applications of CDEC were much more promising. CDEC applied at 5.0 and 7.5 lb/A, gave almost 100% control of purslane on the tops of the beds and had no detrimental effect on the lettuce. Control of purslane below the water line in the irrigation furrow was less effective. However, these weeds are normally removed by cultivation.

APPLICATION OF FINDINGS: From the evidence thus far accumulated it appears that CDEC and possibly CIPC applied pre-emergence may be very effective in controlling purslane in head lettuce. CDEC is less effective against other broadleaf weeds such as mustards and lambs quarters than for purslane.

WORK PLANNED FOR NEXT YEAR: A continuation of the present program but with more emphasis on the more promising materials of this years test.

16. PROTECTION OF CITRUS TREES AND FRUIT FROM FREEZING INJURY.

Project Number: 384. Funds: Research and Marketing.
Personnel: R. H. Hilgeman, T. A. Hales.

During 1955 and 1956, four hundred return stack Hi-Lo orchard heaters, a 7000 gallon storage tank and a 500 gallon field delivery tank were purchased to activate the project. Twelve thermocouples connected with an Electronic recorder were placed in the grove and a Hastings air meter was obtained to measure wind velocity.

During 1955-56, temperature responses from the operation of the wind machine was obtained on two nights, and on the wind machine and heaters on two nights. One heater per 2 trees (total 63 heaters) in the South and East buffer rows was burned for 5 hours on Feb. 3. Progressive firing of heaters in buffer rows for from 1-3 hours was done on March 13. The wind machine was operated on Feb. 4 and 5 although temperatures did not reach 26°F. on the latter night. Results are summarized in Table 1.

TABLE 1

Results of Frost Protection Winter 1955-56

Date	Equip. used	Hrs. wind Mach. Opr.	Min. Temp.	Hrs. blw 26°	Ave. Inv.	Air Drift	Temp. 300 ft. S	Inc. 300 ft. W	around Wind Mach. 300 ft. N	300 ft. E
Feb. 3	Wind & heat	8:00	23.5	3½	7.5	SE	2.0	2.4	1.8	2.0
Feb. 4	Wind alone	8:15	23.2	3½	5.5	*	.5	.0	1.8	.5
Feb. 5	Wind alone	5:30	26.6	-	4.4	SE	.9	1.7	2.1	.7
Mar. 13	Wind & heat	4:00	25.2	1	5.2	SE	.5	1.7	1.9	1.5

*Wind drift highly variable - SE to SW

On the night of Feb. 3 burning the alternate heaters on the outside buffer rows apparently caused a considerable increase in temperature over the normal increase expected from the wind machine alone on the updrift side of the wind machine. This increase may have also been partially caused by running irrigation water on 2.8 acres updrift to the heated area. On March 13 selective firing possibly slightly increased the temperature above the level normally expected with the low inversion which occurred. On the night of the 4th and 5th temperature inversion was small and the wind machine produced a smaller response than has been obtained in previous studies.

On Feb. 2 water at 65° F. was applied to 2.8 acres in Block B at a rate of 1.7 inches per acre. Temperature increases recorded by thermocouples in the center of the area were obtained by comparison with temperatures in adjacent blocks on the east and west. These increases show that water is an efficient source of heat and is more effective when it is running (Table 2).

TABLE 2

Time	Conditions	Temp. Cont. Area	Temp. Irrig. Area	Degrees Increase	Corrected Degrees Increase
9:29	Before irrigation	30.9	31.5	.6	0.
12:03	Water running	29.3	32.5	3.2	2.6
12:33	" "	27.9	31.9	4.0	3.4
1:39	" "	26.4	30.9	4.5	3.9
2:51	Water standing	26.3	28.2	1.9	1.3
5:51	" low	24.6	25.9	1.3	.7
6:51	" gone	24.0	24.7	.7	.1

No damage occurred in unprotected areas, it is evident that the frost protection provided during the winter was unnecessary.

17. FACTORS AFFECTING THE PRODUCTION OF PECANS IN ARIZONA.

Project Number: 398. Funds: Federal. Personnel: L. Burkhart, S. Fazio and J. R. Kuykendall.

Observations during the past year indicate a relationship of sticktights to water deficit and cold damage. Mahan Trees, non-irrigated, Tucson, produced a moderately heavy crop with the majority of the nuts resulting in sticktights. Examination of kernels from sticktight nuts in non-irrigated plots showed a lack of filling and a large percentage contained no evidence of kernel. Trees in irrigated plots contained fewer sticktights and kernel filling was more prominent. Occurrence of frost in early November before the husks fully matured resulted in a high percentage of sticktights of the Mahan variety in the irrigated plots. Fifty to 75% sticktights were noted in this variety but kernel filling was very prominent. Early maturing pecan varieties in irrigated plots showed no evidence of sticktights. At Safford sticktights very serious in Mahan and Burkett varieties. Methods for determining zinc in pecan leaves rechecked.

Insufficient moisture during nut formation appears to increase sticktights. Early maturing varieties should be selected for areas having early frost.

18. LEMON PRODUCTION IMPROVEMENT IN ARIZONA.

Project Number: 405. Funds: Federal. Personnel: C. W. Van Horn, L. Burkhart, G. Sharples, J. R. Kuykendall.

Sampling of Lisbon lemon leaves from commercial orchards and experimental plots on the Yuma Mesa has been under way since September, 1955. The range of N content in leaves from all locations during the summer and fall was from 1.90% to 2.40%. (Mean = 2.12%). During the same period P content ranged from .128% to .249%. (Mean = .197%). The P content was not especially correlated with N content (r = .297). But when the number of chlorotic leaves in each sample was determined and this count was assumed to represent the relative condition of the trees under study with regard to chlorosis, it was found that generally the orchards with the most chlorosis also have the lowest P contents.

Chlorotic lemon trees continued response to iron chelates, especially Sequestrene 138. Mulching young lemons with cotton gin trash and alfalfa improved growth. Additions of nitrogen, phosphate and manure improved fruit production of young lemon trees - Yuma Mesa.

TABLE 1

September 27, 1956 Harvest of Lemons From Fertilizer Trials, Total Number Fruit From Block 23

	N 1	N 2	N 3
P 0 M 0	29	128	77
P 1 M 0	123	338	405
P 0 M 1	306	468	490
P 1 M 1	425	487	629

N 1 1 lb. N. per tree per year
N 2 2½ " " " " "
N 3 4 " " " " "
P 0 No phosphate
P 1 2 lbs. P205 applied in winter
M 0 No manure
M 1 Approximately 2 ton per acre in furrows

Department of
PLANT BREEDING

1. A STUDY OF VARIABILITY IN ADAPTED COMMERCIAL ALFALFA VARIETIES AND METHODS FOR THEIR IMPROVEMENT.

Project Number: 4. Funds: Hatch. Personnel: W. E. Bryan.

A second season study was made of 840 plant progenies, the mother plants of which were selected at random from a commercial field of Hairy Peruvian alfalfa. This study has two objects in view as follows:

1. A study of the variation of the per cent of plant survival, root infection, seed setting, leafiness, and fineness of stem to extend through 3 seasons ending with the close of 1957.

2. To isolate and propagate an improved strain of Hairy Peruvian alfalfa for commercial growing. Notes and studies have been made on these progenies for two growing seasons and these studies will be completed with 1957 season when root studies will be made for possible disease resistance. Seed will be harvested from the more promising progenies for further testing and seed increase.

Further testing by transplanting and propagation by seed in order to establish the best strains is planned for next year.

2. A STUDY OF THE INHERITANCE OF FIBER QUALITIES IN SELFED LINES AND HYBRIDS OF UPLAND COTTONS.

Project Number: 47. Funds: Hatch and State. Personnel: E. H. Pressley, R. E. Briggs, C. D. Manderscheid, C. W. Fitzgibbon.

The following table shows the results of yield and spinning tests on new strains grown on the Cotton Research Farm in 1956. Yield is expressed as a percentage of the yield of 44 which was used as a check.

Fifty-seven progenies of 44 were grown in duplicate for further selection for plant type, length, strength, and fineness. Particular attention was given to fineness as a slightly coarser fiber would be more acceptable. These progenies were selfed so that selfed seed could be supplied to the Cotton Planting Seed Distributors for increase.

A large population of F_3 hybrid material was grown and approximately 500 plants were selected for laboratory study and for planting in 1957.

Strain No.	Yield % of 44	Staple Length	Strength of 22s Yarns	Yarn Appearance Index*	Neps in 100 sq. in. of Card Web
6-6-6-9	109.8	1-1/16	140.7	105	9
6-6-6-12	108.0	1-3/32	141.7	110	9
67-3-2-8	111.5	1-3/32	133.3	115	6
67-3-2-10	114.1	1-1/16	136.4	105	5
67-4-10-6	114.6	1-1/16	131.1	100	7
67-4-10-8	112.0	1-1/16	136.0	105	7
67-6-4-10	115.7	1-3/32	139.2	105	10
67-6-4-12	112.6	1-3/32	144.9	105	6
68-1-3-2	114.8	1-1/16	140.0	110	7
68-1-3-11	118.1	1-1/32	135.6	110	8
68-1-12-5	110.5	1-3/32	139.3	105	8
68-1-12-14	115.4	1-3/32	137.6	115	6
68-2-1-1	117.4	1-3/32	138.4	105	5
68-2-1-11	115.2	1-3/32	134.9	105	7
68-2-2-11	110.5	1-3/32	139.7	105	7
68-3-6-1	118.0	1-1/16	134.9	115	6
68-3-6-6	116.7	1-1/16	128.7	105	9
68-3-7-2	111.3	1-3/32	136.6	110	7
68-3-7-4	118.5	1-3/32	142.1	105	9
68-3-7-7	121.1	1-1/16	137.0	115	3
68-4-2-14	115.0	1-1/16	138.3	110	7
68-4-3-4	111.7	1-3/32	135.1	110	8
68-4-3-10	115.7	1-3/32	136.8	105	8
68-6-1-4	115.4	1-1/16	136.9	110	8
44	100.0	1-3/32	131.5	95	10
44 WR	98.7	1-3/32	136.5	105	5
4-42 WR	93.5	1-3/32	143.7	100	6

*A yarn appearance index of 100 is average.

3. BREEDING COTTON FOR DISEASE AND INSECT RESISTANCE AND FOR PLANT TYPES SUITABLE FOR MECHANICAL HARVESTING.

Project Number: 278. Funds: Hatch. Personnel: E. H. Pressley, R. E. Briggs, W. D. Fisher, Lester M. Blank, A.R.S.

A test in which all available strains that have shown some tolerance to Verticillium Wilt was conducted on the Safford Experiment Farm. Due to poor stands no yields were obtained. However, sufficient fiber was available for laboratory and spinning tests.

Forty acres of land badly infested with Verticillium Wilt were leased near Eloy. All breeding work was transferred from Safford to this field because of its nearness to Tucson and the U.S.D.A. Cotton Station then located at Sacaton. All departments of the Experiment Station interested in cotton and the U.S.D.A. personnel at the Sacaton Station cooperated in this work.

All available wilt tolerant varieties were tested. Strains, plant selections, and hybrid material from West Texas, New Mexico, Arizona and California were grown on the most badly infested part of the field. These were evaluated throughout the year for tolerance to the disease.

One hundred progeny rows of 44 WR were grown in duplicate. These selections varied greatly in the amount of tolerance shown to the disease. A few rows showed only slight leaf symptoms throughout the year and retained all leaves until frost while others were almost completely defoliated by the disease. The best of these selections were sent to Iguala, Mexico, for selfing and increase. Plans have been made to further increase these strains in 1957.

Many of the selections brought in from New Mexico by Dr. Blank showed a high degree of tolerance. Selections have been made from this material for future testing on the same field which has again been leased for 1957.

A foundation field of 100 acres of 44 WR was grown at Aguila, Arizona, under the supervision of the Plant Breeding Department and the Arizona Cotton Planting Seed Distributors. It is probable that there is a sufficient amount of seed of 44 WR to supply the demand in 1957.

4. BREEDING LONG STAPLE COTTON (GOSSYPIUM BARBADENSE) FOR LENGTH, FINENESS AND STRENGTH OF FIBER AND IMPROVED TYPE OF PLANT WITH HIGH PRODUCTION.

Project Number: 294. Funds: Hatch. Personnel: W. E. Bryan.

(a) 108 progenies of crosses and back crosses of advanced and first generation hybrids were grown. Selections were made on the basis of (1) yield, (2) length of lint, (3) plant type and (4) boll size. The original parents of these crosses were Tanguis, Upland, Pima 32 and a sister progeny of Pima S-1. On this basis, 83 selections were made for the production of approximately 11,000 plants in 1957. These selections had lint lengths of 1-7/16 to 1½ inches, with good yield, large bolls and desirable plant type.

(b) 14 additional crosses were made in 1956 in order to make further desirable combinations of characters.

(c) 110 selections were made from a composite including a mixture of all promising progenies listed under (a).

The selections made under 4 (a) constitute an improvement over the commercial Pima S-1 being grown at present. It is expected that further testing of these selections will provide an improved variety which will supplant the present Pima S-1.

The 83 selections listed under 4 (a) will be grown in 1957. These will be re-selected for yield of lint, length of lint, boll size and plant type. Spinning tests will also be made. The results of these tests will be used as a basis for establishing a superior commercial variety. Further breeding stock will be selected from the recent crosses.

5. BREEDING SORGHUMS FOR INCREASED UNIFORMITY IN THE FIELD AND FOR IMPROVED AGRONOMIC CHARACTERISTICS AND INCREASED PRODUCTION OF GRAIN AND FORAGE.

Project Number: 309. Funds: Hatch. Personnel: Lee S. Stith.

The results of the 1956 sorghum research program can be summarized as follows:

1. Hybrid sorghums were introduced into the state for the first time -- commercial or otherwise. Observational plantings were made over the state by two commercial companies, and test plantings were made at Willcox, Mesa and Yuma by the University. The primary result of all the tests and observational plantings was that the late hybrids (usually those pollinated by Plainsman or Caprock) consistently made higher yields than the usual standard varieties for an area.

2. To evaluate the possibilities of hybrid sorghum seed production in this state, tests were made in three locations. At Yuma the seed set on the male sterile rows was negligible and the yield was approximately 10 pounds per acre. At Mesa, the seed set was very poor on the male sterile rows with a yield of approximately 800 pounds per acre when the pollinator rows produced 2500 pounds per acre. At Willcox, the seed set on the sterile row was 95-100% with the yield comparable to Combine Kafir 60.

3. A study was begun to try to determine the cause of seed blasting in the Yuma area. This problem is being studied from the standpoint of relationship of irrigation water, fertilizer and the variety. The plots receiving water at weekly intervals had a low percentage of seed blasting.

4. Standard varieties of grain and forage sorghums were evaluated in tests.

Department of
PLANT PATHOLOGY

1. CONTROLS OF PHYMATOTRICHUM (COTTON OR TEXAS) ROOT ROT IN IRRIGATED LANDS.

Project Number: 42. Funds: Hatch. Personnel: R. B. Streets.

The experiments conducted over a period of years on Field H have shown that it is possible to control even severe infestations of the root rot fungus to the extent that profitable crops of cotton and other susceptible summer crops can be raised year after year. In other words, we now know how to "live with" root rot in the case of annual summer crops.

Cotton: A winter green manure crop of Papago peas gives by far the most practical control of root rot of cotton. Under this system continuous cotton culture can be continued indefinitely. Cotton yields and the per cent of plants killed by root rot were very similar in 1955 and 1956:

	Percent Root Rot		Pounds Seed Cotton/A	
	1955	1956	1955	1956
No Treatment	82.5	82	1295	1198
Ammonium Nitrate 200#/A	91.2	99	1200	1328
Barley - Guar for seed	13.0	12.6	3157	2853
Papago peas	2.2	1.2	2861	2495

Castor Beans: When castor beans appeared as a possible cash crop for summer planting tests were initiated to test their susceptibility to root rot as ornamental varieties were shown to be susceptible. When planted early (May) castor beans were found to be as susceptible to root rot as cotton, but when planted last (following safflower -- mid July to early August) no plants died of root rot but the seed yields were too low.

Summary of Yields and Per Cent Root Rot on Summer Crops:

Crop	Date Planted	Preceding Crop	% Root Rot	Yield#/A
Castor Beans	May 21	Papago peas	0	2327
Castor Beans	June 13	Papago peas	0	2201
Castor Beans	July 18	Safflower	0	871 (low)
Black-eyed Beans		Papago peas	0	707 (low)
Lee Soybeans		Papago peas	0	(weedy, plowed under)
Mesa Guar		Barley	0	547 (low)
Cotton		None	99%	1328 seed cotton

2. CONTROL OF ROOT DISEASES AND VIRUS DISEASES OF CITRUS.

Project Number: 222. Funds: Hatch. Personnel: R. B. Streets, Dr. J. B. Carpenter (U.S.D.A., Indio), C. W. Van Horn.

The growing of virus-free, superior strains of citrus has been continued to furnish a source of buds for the certified bud-wood program initiated in 1955. These are being grown at Yuma.

Dr. Carpenter has given considerable attention to detection of citrus viruses in Arizona groves, and has given special attention to stubborn cases.

Indexing of trees which have grown adjacent to Meyer lemons (which were reported last year to carry a virus) has given negative results. This agrees with field observations that in no case has there been spread of the virus from the Meyer lemon to any adjacent citrus. However, nursery trees of sweet orange on sour root develop quick decline symptoms when buds of Meyer lemon are set in them.

3. DISEASES OF ROOTS AND ROOT-CROWNS OF ALFALFAS IN ARIZONA INDUCED BY SOIL-INHABITING PATHOGENS.

Project Number: 227. Funds: Hatch. Personnel: Paul D. Keener.

Continued studies of alfalfa decline organisms show that species of fungi from the genera Rhizoctonia, Fusarium and Stemphylium are largely responsible for crown rots of non-hardy Arizona alfalfas. Histological studies gave added emphasis to the fact that crown bud primordia are frequently invaded and that this type of infection accounts for the rapid decline of stems, even after some degree of "temporary recovery" takes place. No explanation for the sudden loss of vigor in stems after a brief recovery has been found at this time.

The so-called watery condition beneath the bark of roots of crown-rot infected plants appears to be a function of temperature. In colder seasons this watery material is very prevalent in diseased roots while it is almost entirely absent in normal appearing structures. During the past relatively mild season, this watery condition has been of minor importance. Isolations from the watery material indicate that many types of gas-forming bacteria can grow in it.

One heavy invasion of Phymatotrichum omnivorum was noted in an area near Tucson in Pima County. Alfalfa plants in this area were killed by the fungus. The area is being utilized in studies dealing with possible resistance of alfalfas to this soil-borne pathogen.

4. VERTICILLIUM WILT OF COTTON.

Project Number: 256. Funds: Hatch. Personnel: R. B. Streets, Warner Fisher (Agronomy), Dr. L. M. Blank (A.R.S.).

Field plot work during 1956 was done in cooperation with Dr. Fisher of Agronomy and Dr. Blank of A.R.S. on a 40-acre field of heavily wilt infested land near Eloy. Most of the plot work was concerned with the testing of the wilt tolerance of progenies bred for resistance to wilt, and the effect of environmental factors such as irrigation, type of bed, and date of planting on incidence of wilt. At least one more year's results will be necessary to draw conclusions.

Laboratory work at Tucson has been concerned with the determination of survival of the wilt fungi in cotton stalks and gin trash. One large stack of cotton stalks chopped for supplementary feed for cattle, remained unused and was broadcast on wilt free land. Even after exposure to summer heat and dryness for weeks Verticillium was recovered from random samples. Various samples of gin trash, some of them composted, contain viable Verticillium.

Except in Yuma county where Verticillium wilt has not been reported, cotton stalks and gin trash are not safe materials to add to soils free from Verticillium. The use of this material in the past is no doubt one of the factors in the rather alarming spread of Verticillium in Arizona.

5. VIRUS DISEASES OF VEGETABLE CROPS INCLUDING MELONS IN ARIZONA.

Project Number: 286. Funds: Hatch. Personnel: Paul D. Keener.

1. Tomato fruit collapse in specimens from widely separated localities were shown to be due in part to the presence of mosaic viruses. High virus contents were found in tomatoes from Cochise County where cucumber mosaic strains (Marmor cucumeris strains) were recovered from infected fruits showing collapse. In a shipment of fruits from Old Mexico through the Port of Nogales (Sonora-Arizona), tobacco mosaic virus (Marmor tabaci) was found in high titre. Since both of these viruses are able to continue development at temperatures prevailing during transit and storage, the fruits become unmarketable by the time they reach their destination.

2. Bronze-leaf (including a symptom designated as bronze-vein) was found by the Extension Plant Pathologist, Dr. Ivan Shields, in a field of cantaloupes near Gadeen in Yuma County. Studies with this disorder, which has also appeared sporadically in experimental plots at Tucson, show that mosaic viruses are involved. In addition, there is strong evidence that tobacco ringspot virus (Annulus tabaci) may be present in bronze-vein leaves and stems along with western cucumber mosaic virus. Plants showing symptoms of bronze-leaf and bronze-vein behave quite similarly in late stages of development to plants affected with so-called crown blight. Test plants used as indicators for both Annulus tabaci and Marmor cucumeris show initial symptoms corresponding to those appearing in field-infected cantaloupes, i.e. a darkening to a bronze or bronze-brown color of the main and lateral veins, followed by necrotic sectoring and final collapse of the entire leaf and petiole. This disease indicated from studies during the past year, is sporadic and likely to occur at any time. It is also evident that the disease is NOT the lethal virus described from California during the past few years.

3. Western cucumber mosaic virus has been found in sugar beets and other plants in the Salt River Valley of Arizona. This virus has been known in sugar beets from other areas of the country previously, but it is believed that this is the first recognition of its presence in Arizona. Many other crops are being studied for the presence of this virus and thus far several others have been found to be infected. Studies in host range indicate that the range is very wide for this virus in Arizona. Histological studies are also in progress.

4. Curly-top virus studies during the year showed that tomato plants inoculated with several other viruses, are still highly susceptible and become infected with the curly-top virus (Ruga verrucosans).

6. ANTIBIOTICS IN RELATION TO PLANT DISEASE CONTROL.

Project Number: State 359. Funds: State Research.
Personnel: Alice Boyle and Helen Simonsen.

Laboratory tests have given the following results: Phytophthora dreshleri, P. capsici and Pythium spp. inhibited by Griseofulvin and Fungichromin; Hendersonula sp. (cause of sooty canker of mulberry) and Macrophomina phaseoli inhibited by Pleocidin, Rimacidin, Filipin and Oligomycin; Diplodia sp. inhibited by Pleocidin; Verticillium albo-atrum, Fusarium oxysporium f. niveum, F. oxysporum f. conglutinans and F. oxysporium f. lycopersicum inhibited by Filipin, Rimacidin and Oligomycin as well as by Pleocidin and Fungichromin as previously reported.

Pre-plant applications of the antibiotics in pot tests prevented infecting of plants by above mentioned wilt fungi.

Work on crown-gall control is continuing.

7. DIAGNOSIS OF PLANT DISEASES FOR CITIZENS OF ARIZONA.

Project Number: State 360. Funds: State Research.
Personnel: Alice Boyle, R. B. Streets, P. D. Keener, Helen Simonsen.

Diagnosis of diseases: Well over 800 plant disease problems have been diagnosed, reported upon and control measures recommended when possible. Diagnostic work for the Commission of Agriculture and Horticulture and Crop Improvement Association has continued. This work, as well as that requested by nurserymen, farmers, directly or through County Agents, and for home owners concerned chiefly with diseases of ornamentals has increased during the year. To make correct diagnosis, culturing of plant materials and innoculation of healthy plants with the isolated organisms are often necessary.

New diseases: A new root rot of Safflower caused by Fusarium sp. has been under study. Phytophthora sp. as a root rot of Algerian Ivy.

Diseases unusually prevalent: Puccinia antirrhini in snapdragons more prevalent than usual.

Diseases new to state: Sclerotium rolfsii as a bud rot of strawberry plants.

Diseases of Forest Trees - P. D. Keener: Intensive investigations were carried out relating to fungus diseases of plants throughout the entire State. These studies were directed mainly to diseases of forest trees. Results indicate that diseases common to the entire West and particularly the Rocky Mountain areas, are also present in significant amounts in Arizona. Dwarf-mistletoe (Arceuthobium spp.) is a major cause of damage to conifer trees in the State. Red Rot, due to Polyporus anceps appears to be of some importance. By far the most damaging leaf and needle diseases are due to the so-called needle-cast fungi. Many of these were encountered during the investigation with one on Pinus ponderosa being of considerable interest due to its potentiality in limiting growth increments year after year.

Several fungi new to the State were encountered and in addition, hosts not previously reported for the area were frequently encountered.

A more detailed report of these studies will be presented elsewhere.

Tomato Fruit Collapse: The attempt to develop a fall-tomato deal in Cochise County near Bowie encountered serious difficulties from fruit rots in both the "green wrap" and "pink" fruit. There was practically no rot apparent in the field, but the mature green fruit graded and packed in 60 pound wire bound crates for shipment by truck to the southeastern states, developed 20 per cent "melted" fruit on arrival. Attempts to market partially colored fruit packed in standard tomato flats was abandoned as this fruit developed 33 per cent "melted" fruit.

Laboratory studies of the "melted" fruit showed that the soft rot was due primarily to a fungus Oospora lactis, although Rhizopus nigricans was commonly found. The Oospora rot, called sour rot, or watery rot, often causes a decay in transit or market of tomatoes raised in the southern States.

As the fungus is a wound parasite, suggestions were made, from a study of the methods of picking, handling, grading, and packing fruit, for improvements of sanitation (elimination of decaying fruit and sterilization of boxes) and care in handling to avoid injury to fruit.

A similar situation was encountered in green wrap tomatoes shipped through Nogales, and grown in Sonora, Mexico.

The fruit from both localities showed considerable virus infection, which is reported under virus studies.

8. DIAGNOSIS OF PLANT DISEASES.

Project Number: 360. Funds: State Research. Personnel: R. B. Streets.

Decay of Redwood in Cooling Towers: A request, unique in our experience, for evaluation of rate of decay in large cooling towers of the Sahuaro Power

Plant at Red Rock was received from the utility company last summer following the collapse of filler in a similar installation in Phoenix at the premature age of seven years. Replacement of this smaller unit cost $60,000. The tower was examined, samples taken and examined in the laboratory for chemical and biological damage. The redwood in the tower is constantly leached by hot water, which removes the chemical agents which normally preserve it. The two towers are relatively new, two and three years, and cost $250,000. Thin wood sections made from the samples showed the presence of the mycelium of wood rotting fungi, but no damage to cell structure yet. Samples taken six months later showed an appreciable increase in fungus penetration. As it was evident that protection was needed, the management decided to spend $30,000 in treating the wood by the double diffusion process, which should at least triple the useful life of the towers.

9. DISEASES OF GRASSES IN ARIZONA.

Project Number: State 378. Funds: State Research.
Personnel: Alice Boyle.

During the early part of 1956, several new diseases of grasses came to our attention, making further study necessary and delaying the completion of the bulletin as planned. The two new diseases investigated are a Fusarium root and crown rot and an anthracnose disease.

The work on control for diseases of grasses has been extended.

10. FACTORS INCREASING BOLL ROTS AND FREE FATTY ACIDS IN COTTON SEEDS.

Funds: Research Grant -- Cotton Seed Distributors.
Personnel: R. B. Streets, Alice Boyle, and Helen Simonsen.

Work this year was principally a study of cotton seeds.

The presence of free fatty acids in excess of .5 to .7% in cotton seed oil is very objectionable to oil mills as it gives the oil a darker color and rancid flavor. While such oil can be reclaimed, the treatment is an added expense.

Tabulation of data from 460 samples of cotton seed from the 1955 crop in Arizona fields has been made under Research Grant from Arizona Oil Mills.

The high free fatty acid content which occurred in many lots of seed in the 1954 crop, in a smaller number in 1955, and in relatively few lots in 1956, is correlated directly with the per cent of seed with discolored kernels.

The fungi most frequently isolated from infected kernels were Diplodia, Aspergillus, and Fusarium, in that order. A half dozen other organisms occurred less frequently.

The occurrence of boll rots was seasonal. They were prevalent and severe in early pickings in some districts. Boll rots were scarce in the main picking season, but increased sharply in late pickings, especially the final cleanup picking. This correlates with moisture conditions as summer rains occur during

early pickings, the weather is dry during fall months, but the late pickings often contain many immature bolls and they are subject to morning dews.

Suggestions to Growers: The possible remedies are (1) control of excess rankness by reducing irrigation and fertilizer, (2) spacing not less than six inches in fields producing large plants and (3) improving aeration by bottom defoliation. Skip row planting (plant four, skip four) greatly improves aeration as half the rows are outside rows, and even the inside rows are better aerated.

Suggestions to Oil Mills: Oil Mills may expect to encounter high free fatty acid in early picking and in very late pickings. Poor lots could be detected either by cutting samples on the spot, or by F.F.A. analysis before the lot is mixed with good seed. Years when F.F.A. content is high will probably be infrequent, but oil mills should run a yearly check to detect these bad years.

11. PLANT DISEASE SURVEY.

Funds: Sabbatical Leave Grants.
Personnel: Paul D. Keener.

Other Studies: Intensive investigations were carried out relating to fungus diseases of plants throughout the entire State. These studies were directed mainly to diseases of forest trees. Results indicate that diseases common to the entire West and particularly the Rocky Mountain areas, are also present in significant amounts in Arizona. Dwarfmistletoes (Arceuthobium spp.) are a major cause of damage to conifer trees in the State. Red Rot, due to Polyporus anceps appears to be of some importance. By far the most damaging leaf and needle diseases are due to the so-called needle-cast fungi. Many of these were encountered during the investigation with one on Pinus ponderosa being of considerable interest due to its potentiality in limiting growth increments year after year.

Several fungi new to the State were encountered and in addition hosts not previously reported for the area were frequently encountered.

A more detailed report of these studies will be presented elsewhere.

12. TESTS OF SOME NEW NEMATOCIDES.

Funds: Shell Research Grant. Personnel: R. B. Streets and John H. O'Bannon.

The root knot nematodes have become increasingly important as plant pests in recent years. Soil fumigation has been the most effective control measure, but it's usefulness has been limited by the toxicity of nematocides to living plants. Three new nematocides, reputed to be relatively non-toxic to living plants, have been tested for effectiveness in controlling nematodes and for phytotoxicity.

The nematocides tested were sodium N-methyl dithio-carbamate (Vapam), 1-2-dibromo-3-chloropropane (Nemagon and Fumizone), and 0.24-dichlorophenol, 0.0-diethyl phosphorothioate (V-C-13).

All chemicals proved to be very effective in preplanting treatments, particularly at the recommended dosage and at twice that amount. Vapam proved to be highly toxic to living plants in post planting treatments. The other compounds were not toxic to the plants, but did not eliminate nematodes. However, the damage to plant roots by nematodes was much less than in the controls. Further work will be done to test the duration of effect of treatment. V-13 is a non-volatile slow acting chemical.

Department of
POULTRY SCIENCE

1. ESTABLISHING A HEAT RESISTANT STRAIN OF WHITE LEGHORNS.

Project Number: 363. Funds: Hatch and State. Personnel: M. W. Pasvogel, H. B. Hinds.

This project is now in the third year. Four strains established consist of two large-bodied and two small-bodied strains. Four hundred females representing 52 dam families and 16 sire families were housed in the breeding pens in the fall of 1956. The dams of these hens laid at the rate of 50% during June, July and August, and their total production for the year was 260 eggs or more. These four strains are being maintained and reciprocal crosses of these strains have been made this year. The performance of the pure strains and strain crosses will be ascertained this year.

2. THE UTILIZATION OF ARIZONA CROPS IN CHICKS DIETS.

Project Number: 364. Funds: Hatch and State. Personnel: M. W. Pasvogel.

To a standard milo-soybean meal diet, various fats were added to raise the productive energy content of the diet and to improve the growth and feed efficiency of chicks receiving the ration. The fats tested included a vegetable, animal and fish fat and an animal fat absorbed on an inert mineral carrier. Results of five replicate trials were as follows:

4-Week Results

	Males		Females	
Treatment	Weight	Feed Eff.	Weight	Feed Eff.
1. Control	472 gms.	1.81	410 gms.	1.84
2. 3% Vegetable fat	495 "	1.71	439 "	1.78
3. 3% Animal fat	485 "	1.73	417 "	1.81
4. 3% Fish fat	486 "	1.74	414 "	1.77
5. 3% Dry Animal fat	468 "	1.80	409 "	1.85

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Broilers fed a milo diet usually exhibit no pigmentation in their skin, fat or shanks. Hens fed a milo diet will lay eggs containing pale, lemon colored yolks. In an attempt to increase the degree of pigmentation in broilers and to darken the yolks of eggs, various levels and types of carotinoid pigments were added to the broiler and layer rations. Under the conditions of this experiment, the color of the skin of broilers fed these pigments was not materially affected. Yolk color of eggs laid by hens receiving diets containing a carotinoid-xanthophyll pigment did not change.

High energy diets producing rapid growth may be deficient in certain amino acids or may produce deficiencies in the growing bird. Accordingly, ten different amino acids are now being listed. To date, Glycine, Serine, Valine and Alamine have shown some ability to improve the growth of chicks fed a practical type diet.

3. THE EFFECT OF PACKAGING ON THE SALE OF EGGS.

Project Number: 421. Funds: Hatch and State. Personnel: M. W. Pasvogel, Robert J. Pforsich.

During the short period this project has been under way, it has become apparent that the transparent all-plastic type of egg carton has a stimulating effect on egg sales. During the five weeks prior to the survey the five cooperating super markets sold an average of 2200 dozens of the brand tested. During one week of the survey 3680 dozens of eggs were sold, an increase of 1480 dozens. The survey also indicates that Tucson housewives show a definite preference for cartons with the window in the lid. In addition, it has become apparent that certain housewives in some areas prefer the pulp type carton over the plastic. This trend is the reverse of results noted in other cities.

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December 31, 1956

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